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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT: 1928-29:

S. H. Russell, Bath Lane, Leicester.

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Sheffield: T. R. Walker, 26, Castlewood Road, Fulwood, Sheffield.

Scottish: J. Bell, 60, St. Enoch Square, Glasgow.

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London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

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BRITISH CAST IRON RESEARCH ASSOCIATION.

The Registered Office and Laboratories of the B.C.I.R.A. are at:

24, ST. PAUL'S SQUARE, BIRMINGHAM.

Telephone: Central 1885. Telegrams: CIRA.

The B.C.I.R.A. Scottish Laboratories are:—

Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*)

Forthcoming Events.

FEBRUARY 8.

Institute of Metals (Birmingham Local Section):—Joint meeting at Birmingham. "Electro-Deposition," Paper by D. J. Macnaughtan.

Institute of Metals (Sheffield Local Section):—Ordinary meeting at Sheffield. "Some Recent Developments in Nickel Metallurgy," Paper by W. T. Griffiths, M.Sc., F.I.C.

FEBRUARY 11.

Institution of Heating and Ventilating Engineers (Associates' and Graduates' Branch):—Ordinary meeting in London. "Cast Iron," Paper by J. L. Kinnell, Junr.

Institute of British Foundrymen.

FEBRUARY 1.

Middlesbrough Branch:—Ordinary meeting at Cleveland Technical Institute. "Progress and Precision in Motor Cylinder Manufacture," Paper by W. West.

FEBRUARY 2.

Lancashire Branch:—Joint meeting with the West Riding of Yorkshire Branch.

FEBRUARY 9.

Birmingham Branch (Junior Section):—Ordinary meeting at Birmingham. "Making a Water Turbine Valve Body in Loam," Paper by F. A. Skidmore.

East Midlands Branch:—Annual dinner at Loughborough.

Newcastle and District Branch:—Annual dinner.

Scottish Branch:—Ordinary meeting at Glasgow. "Monel-Metal and other Special Non-ferrous Castings," Paper by Wm. McCulloch.

The Foundry Industry and the Steel Trade.

We have repeatedly emphasised in these columns the connection between iron-founding and the steel trade as a whole. Many founders have no direct connection with the steel trade, and doubtless would not consider themselves as part of it, but we are all deeply concerned with the vicissitudes and fortunes of the heavy industries of which we form an important part. While the various sides of the industry can be, and to some extent are, conducted independently, the buying sources are closely connected. A large order for engineering plant embodies all kinds of material and if there is any tendency for orders to be placed elsewhere than in this country the castings would go with the rest of the material.

It is estimated, for instance, that the Channel Tunnel scheme would involve no less than a million tons of segments apart from other castings and auxiliary machinery and plant. The ironfounder may not appear to have any connection with the difficulties of the steel trade, but he is nevertheless affected by its future.

Is there any measure of agreement as to the difficulties of the steel trade? The suggestion is made that the steel trade itself is reasonably well equipped and organised, but that the blast furnace side, which is an integral portion of the steel trade, is not so well placed. The British furnace has on the whole a very small output, and in this respect our prices for molten pig-iron cannot compare with those of our principal competitors. This obviously has a very direct interest for the foundryman.

Blast furnaces are primarily operated for making pig-iron for steel makers, and there is no doubt that the large outputs are very suited to the trade. At the same time these large outputs make possible reductions in prices, and no doubt some furnaces would be tempted to run foundry pig with the result that the disparity in prices between the pig from the small furnaces or pig from the large furnaces would be greater than it is now. Without suggesting that the pig from the ultra-modern furnace is inferior to that from the small furnace, there is no doubt that it would present differences which the founder would have to take into account, and which would demand a closer degree of technical control.

Ultimately, the number of irons produced for foundry purposes might diminish in number and approximate more and more to one type, and this would intensify the problem.

The founder is thus intimately concerned with the difficulties of the steel trade and of the possible solutions to them. The trade appears to be overcoming its difficulties, but it must not be supposed that this will render the solutions unnecessary, for the partial success of present measures will stimulate that flow of capital into the trade which is an essential preliminary to large operating units and elaborate handling plant.

Belgian Foundry Industry Rationalised.

We consider that Bulletin No. 1 (January, 1929), issued conjointly by the Belgian Foundry Employers' Federation and the Foundrymen's Technical Association is one of the most important received by us for the last decade. The bulletin discloses that Belgium, through the efforts of Mr. Paul Ropsy, has been successful in gathering together the iron, steel, malleable and non-ferrous foundries into one powerful employers' association. Mr. Ropsy is, as he thoroughly deserves to be, its first president.

With the formation of this association there has been a reconstitution of the technical association destined to co-operate with the former in an interesting manner. Primarily, the employers will take over the worry of finance, whilst the technical association will (1) examine the existing State specifications for cast materials; (2) create at Liège a research station; (3) solicit Government aid for their scientific research; and (4) establish branches in four centres—Antwerp, Brussels, Ghent and Charleroi. Mr. Marcel Remy is president of this association.

The Employers' Federation has for its objects the following:—(1) Good relationships between competitors; (2) to act as arbitrators in cases of internal disputes; (3) to extend this later to external differences; (4) to treat with the various State Departments for the regulation of Customs duties, railway freights, and the like; (5) to organise or to co-operate with the organisers of Belgian or foreign foundry trade exhibitions; (6) to establish and publish "customs of the trade"; and (7) to encourage the technical association in every possible manner to help it to attain its objects, which we have detailed above. The very simplicity and comprehensiveness of the joint effort is such that it cannot fail to create a deep impression upon every founder who tries to visualise his own establishment through the eyes of the industry. The myopic founder, who dimly outlines the industry through his own particular factory, will remain unmoved until he finds that mergers, instead of co-operation, have created conditions—unlike the latter—over which he has no control, nor chance of obtaining any.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Engineers' Joint Meeting in Nottingham.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Your East Midlands correspondent has reported the first two lines of the second paragraph of the article, which appeared under the above heading in your issue of January 3, 1929, correctly, but the balance is misreported, for the whole object of my lecture was to "demonstrate" and "prove" that all the statements in those two paragraphs were fallacies! I shall be glad if you will correct this impression in your next issue.—Yours, etc.,

17, Victoria Street, S.W.1. A. S. E. ACKERMAN.

Low Carbon Irons.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Your leader of last week is a valuable stimulus to a much-needed research. Whilst low-carbon pearlitic iron of, say, 2.65 per cent. total carbon seldom give tensile results of more than 15 or 16 tons, I have seen high-carbon pearlitic irons of, say, 3.65 per cent. total carbon, regularly giving very high results of 18 tons or more. In the face of such facts it would appear that tensile strength is controlled by some more potent factor than the percentage of graphite—possibly the size, shape and frequency of the voids.—Yours, etc.,

HORACE J. YOUNG.

3, Central Buildings, Westminster,
London, S.W.1, January 28, 1929.

Graphite in Grey Iron Castings.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—In your issue of the 17th inst., appears an important letter from Mr. W. E. Dennison. The problem was, "What would be the difference in the cast irons obtained by melting *white* pig-iron (containing 1.75 per cent. silicon), and by melting *grey* pig-iron of the same composition?"

Mr. Dennison predicts that the use of the white pig-iron would result in (1) a cast iron containing 1.45 per cent. or less of silicon as against about 1.6 per cent. if the grey pig-iron were used; (2) slower melting rate; (3) increase of oxidation; (4) greater sulphur absorption; (5) a tendency (not explained by silicon content) to produce white iron in the castings, and (6) a sluggish iron to pour.

Whilst unable yet to agree with Mr. Dennison, and whilst my original proposal was framed with the idea of finding out how the graphite in the cast iron would be affected, it is obvious that the suggested research would be valuable also in settling the points raised by Mr. Dennison. It is a highly interesting subject, and the correspondence indicates how valuable is a frank discussion of each other's ideas and experiences.—Yours, etc.,

HORACE J. YOUNG.

3, Central Buildings, Westminster,
London, S.W.1, January 28, 1929.

Magnesium Alloy Castings.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We have read with interest the report published in your recent issue of the Paper, read by Mr. Player at Birmingham, on "The Production and Properties of Magnesium Alloy Castings." We note with interest that Mr. Player has made a special point of giving figures for the strength of sand castings in the form of values obtained from sand-cast test-bars.

Mr. Player states that the values obtained from chill-cast bars are usually 25 to 50 per cent. higher. Mr. Deeley, in his recent Paper on aluminium-silicon alloys to the London Section of the Institute of Metals and Institute of British Foundrymen, gave similar values, not only for the aluminium-silicon alloys but also for the more common aluminium alloys. Consideration of the figures given in these two Papers for sand-cast bars enables a much fairer comparison of the mechanical properties of the more common light alloys for sand castings than when the values for the chill-cast bars cast from the same moulds are used.

This is particularly the case in aluminium-silicon alloy, for the chill-cast bar, as Mr. Deeley emphasised in his Paper, can be exceedingly misleading when used to represent sand-cast aluminium-silicon alloy.

It is interesting to note that sand-cast electron (magnesium alloy) has almost the same tensile strength as modified sand-cast aluminium-silicon alloy, but has an elongation comparable with that of sand-cast L.5 (aluminium plus 13 per cent. zinc plus 3 per cent. copper), and equal to about half that of modified aluminium-silicon alloy.

We note also that Mr. Player states:—"Shock resistance is at least equal to that of aluminium alloys, and liability to deformation under stress is less than in the case of aluminium-silicon alloys.

With regard to the first part of this sentence, we feel that it would be of great general interest if Mr. Player could give some figures for the shock resistance, such as the results of Izod impact test for these, together with the figures given in Mr. Deeley's Paper, would enable a truer comparison of the two types of alloy to be made. With regard to the liability to deformation under stress, we are interested to know by what means Mr. Player has judged that the magnesium alloys are superior to the aluminium-silicon alloys. We feel that this is a somewhat sweeping statement in the absence of any authoritative information on the limiting creep-stress values for the two alloys.—Yours, etc.,

LIGHTALLOYS, LIMITED,
W. H. GRIEVE,
General Manager.

Alpax Works, St. Leonards Road,
Willesden Junction, London, N.W.10.
January 28, 1929.

Well-known Founder to Leave Industry?

We learn with regret that a Continental foundryman, well known in this country, is contemplating entering Holy Orders. His friends, being anxious not to lose such an erudite member of the craft, are doing all possible to dissuade him. One of them has perpetrated the above caricature in order to show him what his appearance will be should he take this step, and this, associated with a little pressure from his British friends, should be sufficient to deter him.

A BILL TO AID the establishment of an iron and steel industry in British Columbia was the principal legislation announced in the Speech from the Throne at the opening of the Legislature in Victoria.

Random Shots.

Talking of the Channel Tunnel, while it would not be likely to have much direct effect on our own trade, its construction would be a matter of some considerable interest to our friends the engineers. A point that will, for instance, demand attention is that, in order to avoid too steep a gradient, the descent from ground level to tunnel level will have to cover no small distance. Then there is the question of flooding, which must, for military reasons, be possible from either end. And will there be one tunnel or two, one for traffic in each direction? And will the difference in loading gauge as between English and Continental rolling stock necessitate a change of train? It is estimated that the construction would take about 12,000 men four years to complete.

* * *

My prophecy as to the difficulty of finding a substitute for Rationalisation has been fully justified. The winning word in the competition I referred to a week or so ago was "Marshalling," but the judges admitted that it was not a very great improvement, and they added that the original, ugly though it is, has far too great an international currency by this time to be lightly set aside. Some of the rejected alternatives were weird in the extreme. Among the frankly manufactured words I was specially entertained by "pepication" and "purefficunity," while "Mondism" struck me as being a scarcely deserved but not ungraceful compliment. It was evidently a gentleman of pronounced views who suggested "Robotisation," and, in addition to his advanced views, he could hardly have been endowed with a very sensitive ear if he honestly thought his suggestion any more euphonious than "Rationalisation" itself.

* * *

Professor Eddington's new work on the atom has recently brought him into some prominence, and there has been the usual outcrop of tit-bits about scientific gentlemen and their ways. One enthusiast—possibly a lady—describes Professor Eddington as young, tall, and strikingly good-looking. He—or she—adds that he is in this unlike the typical professor of humorous fiction—although you do very occasionally find that real life is stranger than fiction in the matter. Someone else used the occasion as a peg upon which to hang some gossip about favourite recreations of eminent men, citing cross-word puzzles, stamp collecting, and so on.

* * *

I fancy I would not go unsupported if I were to say that to the layman the most popular recreation of gentlemen with a scientific bent appears to be the reading of detective stories. Men who have never in their lives read any other kind of fiction are able to discuss learnedly the rival methods of one famous author's "Hanaud" and Mr. Freeman Wills Croft's "Inspector French." Men who are on all other occasions overwhelmed by the serious aspect of life will permit themselves a moment of relaxation to compare the merits of murder by revolver-shot—which is noisy—murder by drowning—which is messy—and murder by stabbing—which is fantastic—as a foundation for a good yarn.

* * *

And has not Mr. Stanley Baldwin set the seal of his approval on the habit by public recommendation of one such book? What more do you want?

* * *

The big business man had died and gone to—well, not heaven. But hardly had he settled down for a nice long smoke when a hearty hand slapped him on the back, and into his ear boomed a familiar voice—the voice of a persistent salesman who had pestered him so much on earth. "Well, Mr. Smith," chortled the salesman, "I'm here for the appointment." "What appointment?" "Why, don't you remember" said the other. "Every time I came into your office you told me you'd see me here!"

MARKSMAN.

I.B.F. Elects New Members.

At a meeting held at the Queen's Hotel, Birmingham, on January 19, the following were elected to its various membership grades:—

As Subscribing Firms.

Wm. Cumming & Company, Kelvinvale Mills, Maryhill, Glasgow, iron and steel founders, and J. M. Rodger & Son, Kyle Foundry, Ayr, iron-founders.

As Members.

H. A. Baird, steel founder, Clyde Steel and Engineering Works, Hamilton; W. H. Bamford, works chemist, A. Wiseman, Limited, Birmingham; J. Bennett, foundry foreman, Lightfrill Iron Works, Stroud, Glos.; T. G. Bird, manager, Armstrong, Whitworth & Company, Gateshead-on-Tyne; H. S. A. Branson, metallurgical engineer, Zakl. Mech. Ursus. p. Wlochy k/Warszawy, Poland; J. Curtis, Charlestown Foundry and Iron Works, St. Austell; J. Gibb, engineer and foundry manager, Coltness Iron Works, Newmains; T. W. Jopling, managing director, Pallion Steel Works, Sunderland; W. Scott, works manager, Close Works, Gateshead-on-Tyne; G. Shaw, consulting chemist, 497a, Shields Road, Walker Gate; J. Wallis, traveller, General Refractories, Limited; A. V. Goddard, manager, J. & J. Dyson, Limited, Attercliffe Road, Sheffield; E. Bullock, Lee, Howl & Company, Tipton; W. T. Hobkirk, managing director, J. Hobkirk & Sons, Elstow, Beds.; J. Jefferson, works manager, Sim Foundry, Coatbridge, Glenmaris; A. McCance, director, Clyde Alloy Steel Company, Motherwell; and F. M. Fisher, sand quarry manager, Bramcote Sand Quarries.

As Associate Members.

J. Alston, foreman patternmaker, Bonlea Foundry, Thornaby-on-Tees; J. O. Buttriss, iron, steel and brass moulder; B. Callis, mechanical engineer, H. Morris, Limited, Loughborough; T. Cook, foreman moulder, Clyde Alloy Steel Company, Limited, Motherwell; J. E. Crabtree, underforeman moulder, Howard & Bullough, Accrington; F. Cryer, foreman moulder, Metro-Vickers, Trafford Park; W. Dunkerley, works chemist, Crossley Bros., Openshaw; T. Ferguson, foreman patternmaker, Shanks & Company, Barrhead; E. Halliday, foundry foreman, J. Whitehead & Company, Preston; A. Harrison, production engineer, Parkinson & Cowan, Limited, Stretford; A. Howell, foreman patternmaker, Tubal Cain Foundry, Cardiff; T. A. Jervis, foundryman, W. Lee & Sons, Dronfield, Sheffield; W. D. M. Kennedy, clerk, Bar Lea Foundry, Thornaby-on-Tees; F. C. Pearce, foundry superintendent, British Piston Ring Company, Coventry; W. Phillips, foreman moulder, Grangemouth Iron Works, Falkirk; H. P. Radford, foundry cost clerk, S. Russell & Sons, Leicester; A. Rae, foreman, T. Allan & Son, Bonlea Foundry, Thornaby; J. Richardson, foreman, Howard & Bullough, Accrington; L. W. Seymour, moulder, W. Wilder & Sons; W. Smith, iron moulder, Metropolitan-Vickers; G. T. Snaith, core maker, North-Eastern Marine, South Dock; G. H. Spedding, metallurgist, Bond's Foundry Company, Tow Law; W. Stokes, foreman moulder, Tubal Cain Foundry, Cardiff; J. Thompson, foreman moulder, Metropolitan-Vickers, Trafford Park; A. Thornton, master patternmaker, 48, Baxter Gate, Loughborough; A. S. Wall, representative, Thos. E. Gray Company, Limited, London; A. Whitton, foreman, Howard & Bullough, Limited, Accrington; H. Bradbury, foreman iron moulder, Kaye & Company, Huddersfield; J. Brownlee, foreman patternmaker, North British Steel Foundry Company, Bathgate; A. E. Burgess, core maker, W. Hammond & Company, Syston; G. H. Burgess, moulder, W. Hammond & Company, Syston; W. Clark, moulder, W. Hammond & Company, Syston; G. Dexter, core maker, W. Hammond and Company, Syston; E. Dunn, core maker, W. Hammond & Company, Syston; A. Eaton, cast-iron moulder, L.N.E.R. Plant Works; A. O. Greasley, moulder, W. Hammond & Company, Syston; F. H. Perkins; and R. Wilson, patternmaker, H. Lloyd & Company, Wednesbury.

As Associates.

J. H. Barrett, apprentice patternmaker, Armstrong-Whitworth, Limited, Gateshead; E. Birks, apprentice brass moulder; W. Cook, apprentice engineer, Bond's Foundry, Tow Law; R. Errington, coremaker, Clarke, Chapman & Company, Gateshead; C. S. Gibson, iron moulder, N.E. Marine Company, Wallsend; T. W. Gibson, steel moulder; R. Jennings, apprentice patternmaker, C. A. Parsons & Company, Heaton Works, Newcastle; T. Mark, apprentice patternmaker, Armstrong-Whitworth & Company, Gateshead; G. S. Miller, patternmaker, Seaham Foundry Company, Limited; A. M. Moat, iron moulder, N.E. Marine Company, Wallsend; C. R. McDonald, iron moulder, N.E. Marine Engineering Company, Wallsend; H. McErlane, moulder; E. Nixon, moulder, F. Turnbull, Heaton Junction, Newcastle; E. Noble, iron moulder, F. Turnbull, Heaton Junction; T. E. Reece, apprentice moulder; J. B. Slasser, apprentice coremaker, Armstrong-Whitworth, Limited, Gateshead; G. E. South, patternmaker, Laycock Engineering Company, Millhouses; W. Townsend, iron moulder, N.E. Marine Engineering Company, Sunderland; A. Fox, clerk, Beacon Foundry, Walsall; and B. B. Kent, works assistant, Sterling Manufacturing Company, Cubitt Town, E.14.

Branch Presidents—No. 2.

Newcastle Section.

Mr. Colin Gresty, president of the Newcastle Branch, is foundry manager and works metallurgist of the North-Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne. He entered the laboratory of this company a few months after its establishment in 1911, and was chief assistant to Mr. H. J. Young until the latter left

MR. COLIN GRESTY.

the company at the end of 1925 to take up consulting work. Mr. Gresty succeeded him as works metallurgist, and about 18 months ago was appointed foundry manager in addition. In the course of his experience he has visited many foundries in this country and on the Continent.

He joined the Institute of British Foundrymen in 1917, and has been actively identified with the Newcastle Branch since that time, serving also for some years as a representative of the Branch on the General Council. He was honorary secretary for the Annual Convention of the Institute held in Newcastle in 1924, and Branch secretary from 1924 until 1927. He has also interested himself in the Newcastle Junior Section, and has read Papers before both the Senior and Junior Sections, being awarded the Diploma of the Institute for his Paper, read in 1923, on "The Examination and Photography of Cast Iron under the Microscope." He is also a member of the Iron and Steel Institute and the Institute of Metals.

Institute of Metals.

Annual General Meeting and "Coming of Age" Celebrations.

As previously announced, the Twenty-first Annual General Meeting will be held, by kind permission, in the Hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, on Wednesday and Thursday, March 13 and 14.

On March 13 the Annual Dinner of the Institute will be held at the Trocadero Restaurant, Piccadilly Circus, W.1, at 6.45 for 7 p.m. The dinner will be followed by a dance, ending at midnight.

To celebrate the "Coming-of-Age" of the Institute a Conversazione will be held at the new Science Museum, South Kensington, in the evening of March 14, in connection with which a metallurgical exhibition is being arranged.

The British Industries Fair Management Committee have invited the Institute to make an official visit to the Fair, and have invited the party, limited to 200 members of the Institute, to luncheon. The visit has been arranged for Thursday, February 21.

Papers.

The following Papers are expected to be submitted:—

Recent Developments in Electric Furnaces, by D. F. Campbell, M.A., A.R.S.M.

An Improved Form of Electric Resistance Furnace, by W. Rosenhain, D.Sc., F.R.S., and W. E. Prytherch M.Sc.

Note on the Testing of Electro-deposits on Aluminium, by G. B. Brook, F.I.C., and G. H. Stott, B.Sc.

The Importance of Design, and Setting of Large Kettles Used for Refining and Low Melting Point Alloys, by H. C. Lancaster.

Brittleness in Arsenical Copper.—II, by Clement Blazey, M.Sc.

Special Properties of Eutectics and Eutectoid Alloys in Binary Metallic Systems, by Professor P. Saldau.

Work-Softening and a Theory of Intercrystalline Cohesion, by F. Hargreaves, A.R.S.M., and R. J. Hills.

The Age-Hardening of Some Aluminium Alloys, by Marie L. V. Gayler, D.Sc., and G. D. Preston, B.A.

The Constitution of the Cadmium-Rich Alloys of the System Cadmium-Gold, by P. J. Durrant, M.A., Ph.D.

The System Magnesium-Zinc, by W. Hume-Rothery, M.A., Ph.D., and E. Rounsefell, B.A.

Alloys of Zirconium.—II, by C. Sykes, M.Sc.

The Resistance of Zinc to Indentation (A Preliminary Account), by J. Newton Friend, D.Sc., and W. E. Thorneycroft, B.Sc.

The Solution of Plain and Amalgamated Zincs in Electric Batteries, by J. Newton Friend, D.Sc.

The Silver Contents of Specimens of Ancient and Mediæval Lead, by J. Newton Friend, D.Sc., and W. E. Thorneycroft, B.Sc.

A Note on the Haughton-Hanson Thermostat. A Method of Fine Adjustment, by P. J. Durrant, M.A., Ph.D.

Autumn Meeting.

Members are reminded that the Annual Autumn Meeting will be held in Düsseldorf, Germany, in September, the date of the meeting being September 9-12 (provisional). As this is the first meeting of the Institute to be held in Germany, it is hoped that there will be a good response to the warm invitation that has been received from the Verein Deutscher Ingenieure and Deutsche Gesellschaft für Metallkunde, which Societies will be the Institute's hosts on the occasion of the forthcoming meeting, details of which will be announced later.

New Members.

Though the membership of the Institute reached 2,000 for the first time on December 31, 1928, the Council trust that the Institute's membership will continue to increase during the present year, which marks the twenty-first anniversary of the Institute's foundation. A meeting of the Council will be held on February 21 for the purpose of considering applications for membership.

New Universal Microscope (Vickers' Pattern).

In the industries engaged upon the production or manipulation of metals the microscope has of necessity become an important addition to the equipment of test house and laboratory, no analyses, or tests for the mechanical properties of metals can in themselves furnish sufficient information which should lead to corrections in errors of manufacture or improvements in quality. The real value of analysis and physical test only becomes possible when considered in conjunction with a microscopical examination.

For many years Messrs. W. Watson & Sons, Limited, High Holborn, London, have specialised in the manufacture of microscopes for metallurgical work, their standard instruments will therefore be well known to our readers. Fig. 1 shows a recent development, actually a universal microscope for visual examination by transmitted light (general) and reflected light (metallurgical), photomicrography, projection, comparison and drawing.

This system has all the attributes of the Le Chatelier design and possesses in addition the advantage of a comparator system. As will be appreciated from the appended description, it is the simplest of the various instruments at present on the market to use, whilst its manipulation can be mastered by any laboratory assistant after ten minutes tuition.

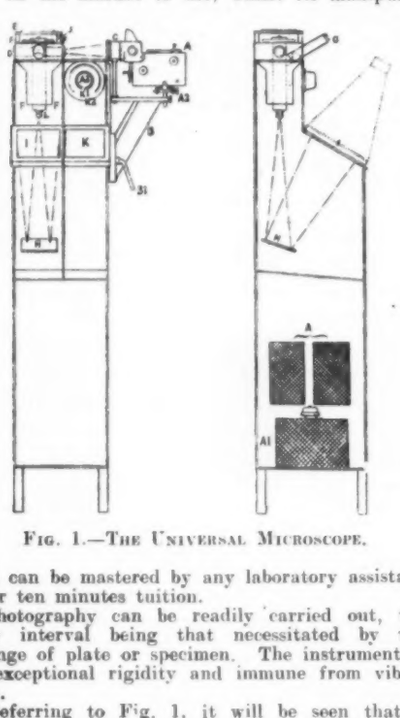

FIG. 1.—THE UNIVERSAL MICROSCOPE.

Photography can be readily carried out, the only interval being that necessitated by the change of plate or specimen. The instrument is of exceptional rigidity and immune from vibration.

Referring to Fig. 1, it will be seen that a double system of illumination is provided, the methods being by arc lamp or Pointolite lamp, these being mounted on the bracket B at right-angles to each other. The side view of the apparatus shows the two resistances "A" for the arc lamp and resistance "A1" for the Pointolite lamp.

Adjustment for the illumination is provided by the tangential screw "A2" and a dropping system is installed which causes the lamp hood to rise and thus obviates any risk of scratching the condenser "C" when the lamp is rotated out of its axis to give place to the Pointolite lamp. For the illumination of transparent objects when examination by transmitted light is employed, or of large objects in macrophotography, the whole of the illuminating system is raised on the dovetail slide to which the bracket B is attached and can be readily clamped by the handle B1. The illumination "A3" of comparative photography will be dealt with later, when the comparative system is explained.

For setting up, the condenser "C" is at its correct point for any system, and a ground glass screen D is fitted at the extreme end of the vertical illuminator tube, so that it is possible during a photographic exposure, or during visual work, to watch any variation in the position of the crater of the arc and to correct on the screen "A2."

Metallurgical Use.

In metallurgy the object is mounted on the stage "E," which stage is provided with centring screws having a range of travel of 1 in. For macrographic objects a supplemental stage is fitted, which will permit the use of long focus photographic objectives. The microscope tube carrying the objective and eyepiece is mounted in a heavy cast-iron block "F," permanent alignment being thereby attained.

The visual tube "G" can be inset in the optic axis and the specimen observed in the ordinary manner. It will be found, however, that considerable relief from strain and comfort in working is obtained by examining the projected image which is reflected from the stainless-steel mirror "H" to the viewing screen "I." All objectives are mounted, par focal, and thus the only focussing necessary is that for which a fine adjustment is requisite.

A wide-milled collar "J" is provided, to which a tommy pin is fitted, and with this highest power oil immersion objectives can be focussed with ease.

An advantage of the examination of the projected image which appears on the screen at a height of three feet from the ground level, and at a convenient angle, is the elimination of ocular fatigue. It can also be employed for drawing by mounting tracing paper on a plain glass plate instead of the ground glass focusing screen, for the exact measurements of areas by means of a planimeter, for comparison purposes, or for photography. For this latter purpose the instrument is so rigid that after the image has been focused on the screen, repetition photographs can be carried out, or fresh areas of the same specimen or new specimens photographed with a minimum of delay.

The Comparator System.

The comparison system consists of a central lamp "A3" surrounded by a dimming filter "K1." A transparency of a photograph of a standard specimen is placed at the aperture K, light from the metal filament lamp "A3" is reflected on to the transparency. Equalisation of the light between viewing screens "I" and "K" is attained by rotating the dimming filter "K1."

When examining coloured objects the standard transparency may if desired be produced by the Autochrome process, or may be tinted with a colour filter to match the original.

Examination by Transmitted Light.

There is an increasing appreciation of the importance of correct graduation of foundry sands, sizes, and forms of dust, etc. For this purpose a supplemental attachment to the plain stage shown on Fig. 1 is provided. This attachment carries mirror and sub-stage condenser. The lamp rising on its bracket is brought to a level corresponding to the centre of the microscopic mirror, the light is thus projected from the condenser to the objective. A new system of changing objectives is employed, obviating the necessity for screw threads, and existing objectives can be fitted to adapters for this purpose, special objectives are not required. The eye-pieces are easily interchanged, a door in the apparatus being provided for this purpose.

The apparatus itself is constructed of angle iron, welded and covered with steel sheet, whilst the ground space covered by the complete apparatus does not exceed 3 ft. by 2 ft.

AN ADDRESS on "Income Tax" was given by Mr. J. de Looze (secretary of Rolls Royce, Limited) to the members of the firm's Foremen's Club.

ISAAC MACHIN, a moulder, of 19, Watt Street, Nottingham, who was employed at Messrs. Manlove, Alliott & Company, Limited, ironfounders and engineers, of Ilkeston Road, has died as a result of a burn on his foot from molten iron.

Derbyshire's Oldest Smithy.

Probably the oldest smithy in Derbyshire is that at Alvaston, which was built over 200 years ago by a Mr. Coxon.

The Coxon family worked the smithy until 1870, who were reputed to be the best bullock shoeing firm between Liverpool and London, and the loops and chains to which the cattle were fastened are still to be seen.

The firm of Coxon's did not only carry on the shoeing business, but were well-known tool makers, and in their small foundry produced machinery for Australia for clearing the bush and tilling the soil. The business was taken over in 1870 by Mr. David Dean, who was apprenticed to the Coxons. The late Mr. Dean's son succeeded his father, he himself having been apprenticed at the small foundry when eleven years old.

Patent Specifications Accepted.

The following list of Patent Specifications accepted has been taken from the "Illustrated Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each. The last numbers given are those under which the Specifications will be printed and abridged, and all subsequent proceedings will be taken.

21,377. WHITE, A. E. (Allen, S. G.). Methods of operating blast furnaces. 303,206.

21,378. WHITE, A. E. (Allen, S. G.). Methods of reducing ores to obtain ferro-alloys. 303,207.

16,770. AKT.-GES. BROWN, BOVERI ET CIE. Electric annealing furnaces of the resistance type. 273,320.

25,073. MEACHER, W. Machine for removing the surface-scale from metal plates. 302,968.

25,734. SHORTER, A. E., BOUCHER, C. L., and PATENT GEAR HARDENING COMPANY, LIMITED. Method of hardening metal surfaces. 303,196.

26,755. IMBERY, A. Electric furnaces for heat treatment and forging. 303,222.

10,062. SOC. ANON. LE NICKEL. Extracting pure nickel from its alloys. 288,605.

16,149. METROPOLITAN-VICKERS ELECTRICAL COMPANY, LIMITED. Manufacture of non-ferrous alloys. 291,462.

25,963. CORSALLI, F. W. Refining metals and alloys. 303,094.

28,575. MEYER, DR. H. Manufacture of steel. 281,621.

6,393. MOND, A. L., (METALLBANK UND METALLURGISCHE GES. AKT.-GES.). Copper-silicon alloys. 303,684.

2,548. SOC. ANON. D'OUGREE-MARIHAYE. Railway chairs. 300,893.

19,971. DEBUCH, C. P. Treatment of ores with gases in rotary furnaces. 303,072.

25,382. CUSHING, D. Metallurgical furnace. 303,042.

Gazette.

ANGLO-GEORGIAN MANGANESE IMPORTS, LIMITED, are being wound up voluntarily. Mr. H. W. Dunn, 32, Old Jewry, London, is the liquidator.

THE KINGS NORTON METAL COMPANY, LIMITED, is being wound up voluntarily, with Mr. G. Norton, of Lion Works, Witton, Birmingham, as the liquidator.

THE TITAN FOUNDRY & ENGINEERING COMPANY, Limited, is being wound up voluntarily. Mr. E. S. Foden, 15, Merchants Exchange, Cardiff, is the liquidator.

SIR WILLIAM ARROL & COMPANY (SWANSEA), Limited, are being wound up voluntarily, with Mr. Alex. Morrison, 34, West George Street, Glasgow, as the liquidator.

Reports and Dividends.

Kerr, Stuart & Company, Limited.—Profit, £27,787; brought in, £32,125; interest charges and depreciation, £18,978; carried forward, £40,934.

A.B.C. Coupler and Engineering Company, Limited.—Interim dividend of 2½ per cent., less tax, on the ordinary shares.

Smith's Dock Company, Limited.—Profit, £85,224; brought in, £21,790; dividend of 6 per cent., less tax, on the ordinary shares; to reserve, £15,000; carried forward, £22,015.

The Development of High Duty Cast Iron.*

By F. D. CORBIN, Llanelly.

During the last few years there has been a great deal of discussion as to the relations between technology and practice, and it must be emphasised initially that no metallurgist who knows what he is doing imagines that he can come into the foundry from outside and teach the foundryman his job; on the contrary, it is the duty of the metallurgist to come into the foundry with his contribution to the common work and co-operate with the working foundryman, who, in his turn, can teach the technically-trained metallurgist a very great deal. It is by this co-operation and mutual learning that progress would be made.

Fundamental Conceptions.

Cast iron is fundamentally an alloy of iron and carbon, normally containing between 3 and 4 per cent. of the latter element and smaller amounts of other elements whose chief influence, except in the case of phosphorus, is either to retard or to accelerate the changes which take place in the iron-carbon system on cooling from the molten state. Thus, while allowing for their influence, it can be considered that the iron-carbon relationship is the vital one to be studied.

The manner in which many metallic alloys of two constituents cool from the molten state and form their structures is now well known, and this matter is of great importance, as it is the foundation of all the knowledge of the structure of cast iron. Considering an alloy containing two materials, A and B, whose melting points in the pure state are fixed and definite, by adding a little A to B the melting point of the product is lowered. This also is the case if a little B is added to A, and somewhere between the two pure metals there is some definite critical proportion of the two which has the lowest melting point of the whole series. This is known as the eutectic composition of the A-B system, or more simply the A-B eutectic.

When alloys of other than eutectic composition cool from the molten state and set, that constituent which is in excess first sets out as solid crystals, frequently taking a little of the other with it in solid solution. This goes on with falling temperature until the remaining molten metal, continually loosing the excess constituent, has reached the eutectic composition, when it freezes, thus giving a structure composed of crystalline grains of the excess constituent set in a framework of the eutectic.

Micro-Constituents.

Cast iron may be considered as an alloy of carbide of iron with iron, the latter on crystallising into the solid state containing 1.7 per cent. of carbon in solid solution, this solid solution being known under the name of "Austenite," after Sir William Roberts-Austen, the famous metallurgist. Carbide of iron occurring as crystals in a metal structure is known as "cementite." The eutectic composition of these two is approximately 50 per cent. of each, the actual carbon-percentage being 4.3. This is, in practice, lowered by the presence of various impurities, but, nevertheless, generally remains a little higher than the amount contained by good cast iron: consequently such a metal as it contains rather less carbon and rather more iron than the eutectic has a structure just after solidification consisting of small quantities of austenite bedded in a ground mass of the eutectic, which, when examined under the microscope at very high magnifications, is seen to be a very fine mechanical mixture of the two. If the iron is of exactly eutectic composition, then the structure will, of course, consist solely of eutectic grains, and if it contains more than the critical amount of carbon crystals, free cementite will appear.

It is necessary at this point to remember what happens to the austenite on further cooling. It is not stable at ordinary temperatures and breaks down at about 700 deg. C. into "pearlite." By this time it will have lost much of its carbon, and before the pearlite crystallises out, either carbon-free iron (ferrite) or carbide of iron (cementite) is set free, depending on whether the austenite by this time contains either more iron or more carbon than the pearlite composition: this is about ¾ per cent. of carbon, and pearlite may be described as a sort of extremely fine solid "emulsion" of carbide of iron with pure iron, *i.e.*, of cementite with ferrite. In fact, the solid solution at about 700 deg. C. behaves exactly like a liquid solution at above 1,100 deg. C., and the pearlite is very much like a eutectic in its behaviour.

Returning now to the typical cast iron, at a temperature which is just under the solidification point the carbon is all in combination or solution, and the structure consists probably of either a little austenite or a little cementite set in a ground mass of austenite-cementite eutectic. If the iron were now cooled very rapidly by chilling, the only change would be that the austenite would turn into pearlite, setting free still more cementite, and this is the structure of white-iron, as shown in Fig. 1, a microphotograph taken at a magnification of 100 diameters, in which the large dark patches are pearlite, the large white patches cementite (also some phosphide), and the mottled structure eutectic.

The exact mechanism of what happens if the metal is *slowly* cooled is still undecided, but it may be taken that the cementite begins to split up at a temperature from 10 to 50 deg. C. below the completion of solidification, forming flakes of free-graphite plus further austenite. This is known as primary-graphitisation, and forms the coarser flakes in the metal (Fig. 5). As the temperature continues to fall, the austenite in its turn begins to give off graphite (secondary-graphitisation, fine flakes), thus losing its carbon continuously right down to its transformation into pearlite, by which time it may contain more or less than the pearlite-composition, or perhaps just exactly this amount.

FIG. 1.—STRUCTURE OF CHILL WHITE IRON ×100.

FIG. 2.—STRUCTURE OF "MOTTLE," SAME PIECE AS FIG. 1 ×100.

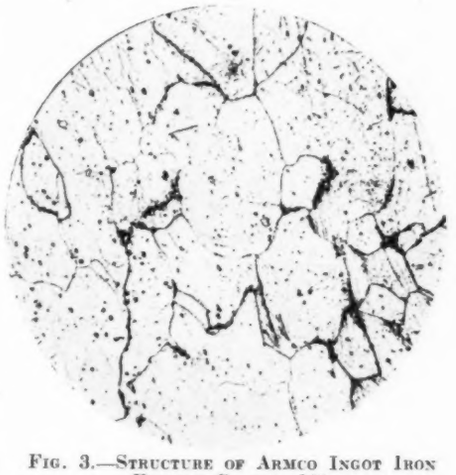

FIG. 3.—STRUCTURE OF ARMCO INGOT IRON FERRITE GRAINS ×100.

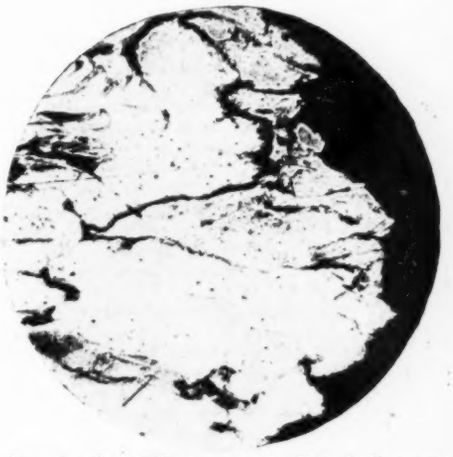

FIG. 4.—SAME MATERIAL AS IN FIG. 3. SECTION THROUGH EDGE OF FRACTURE UNDER TENSILE STRESS. DISTORTED AND TORN FERRITE GRAINS ×100.

Fig. 2 shows the mottle in the same piece of metal a little further away from the chilled edge. The dark masses are pearlite and the little worm-like grey streaks are the first specks of graphite. It will be noted that the right-hand edge of this photograph shows a structure consisting chiefly of graphite-flakes set in pearlite. The pearlite in this specimen has been artificially darkened by staining with acid for the sake of demonstration.

Properties of Micro-Constituents.

The structure is now comprised of flakes of graphite set in a metallic matrix which consists of grains of pearlite mixed with grains of ferrite, or grains of pearlite mixed with grains of cementite, or, possibly grains of pearlite only, this structure being controlled obviously by the extent to which the metal has "graphitised" during cooling.

Table I shows some of the mechanical properties of these constituents.

This table shows that ferrite is soft and only

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* A Paper read before the Wales and Monmouth Branch of the Institute of British Foundrymen, Newport, January 12, Mr. Kinsman presiding.

moderately tough, pearlite is hard and very strong, and cementite intensely hard and very brittle. It is obvious that a matrix (that is to say, the metal part proper as distinct from the graphite) consisting entirely of pearlite grains will be the toughest, while free-cementite in particular is a most undesirable constituent. This explains why those cast irons which consist entirely of graphite and pearlite generally give, other things being equal, the best results.

TABLE I.—*Properties of the micro-constituents of cast iron.*

Constituent.	Max. stress. Tons per sq. in.	Elongation per cent. in 2 in.	Brinell hardness.
Free Ferrite ..	22	40	95
Pearlite ..	56	10	240
Free Cementite	2 (?)	0	500–600 (?)

The other elements in normal cast irons, neglecting occluded gases, are silicon, sulphur, manganese and phosphorus. The first three exert their main influence by affecting the completeness or otherwise of the carbon-iron structural-changes, but phosphorus has structure-forming properties of its own. It forms a eutectic with iron and carbon containing 6.9 per cent. phosphorus, 91.2 per cent. iron and 1.9 per cent. carbon, having a melting point of approximately 980 deg. C. In the presence of the same conditions which cause graphite to be deposited by cementite and austenite this phosphide-eutectic splits up, also depositing graphite, and forms a second carbon-free eutectic of iron and phosphide, of iron, containing 10.2 per cent. of phosphorus. This second eutectic is the phosphide-constituent which is found in grey cast irons. This matter was investigated many years ago by Cook and Hailstone, whose work remains the chief research on this subject of any practical value to the foundryman.

Influence of Phosphorus.

The phosphide is in itself hard and brittle, but not as markedly so as cementite, and a well-marked network-structure of this constituent seems to be a feature of good, strong irons. Broadly speaking, Messrs. Cook and Hailstone's investigations show that those factors which favour a good general graphite condition also favour a good network-structure of the phosphide, so that one may concentrate upon carbon-iron considerations.

For present purposes cast iron may be roughly summarised as a matrix of impure steel, containing non-metallic flakes of graphite, and semi-metallic masses or spots of phosphide-eutectic, which merely break up the continuity of the steel structure without contributing any strength of their own.

The manner in which structures consisting of pearlite or ferrite grains rupture under stress is known as plastic-deformation. On a light stress being applied and released the piece having been slightly distorted returns to its original shape. On applying a heavier stress, which is just above the elastic-limit of the material the individual grains become permanently distorted, giving "permanent set." With still greater stresses this distortion increases until the breakage-point is reached, when the material fails by a cleavage of the internal structure of individual grains, the breakage invariably occurring *through* the grains and not at their boundaries.

Fig. 3 shows a piece of Armco ingot iron, which consists almost entirely of grains of pure ferrite, and Fig. 4 is a section through the same piece at the point of fracture under tensile stress. It will be noted that the grains are all drawn out and distorted, also that they are torn through, not parted at their boundaries.

Fig. 5 shows a section through the fractured edge of a piece of cast iron. This has not been acid-etched so that the white material is metallic matrix and the dark streaks are graphite. It is very obvious that the grains have not been drawn out or distorted and that fracture has taken place at the boundaries. Fig. 6 shows the same spot after etching. The grey streaks are graphite, the dark ground mass pearlite, and the white patches free ferrite. Fig. 7 shows another spot in the same piece of metal acid-etched.

In the case of cast iron, it is the non-plastic inclusions of graphite which cause the metal to give way long before the actual grains of the matrix are stressed to anywhere near their breaking point, and the graphite-flakes exert their weakening influence in two ways. In the first place, they obviously split up the continuity of the metal proper; in the second, when the flakes are sharp-angled in form, they provide "cuts" in the structure at their edges and corners which act like the nick made by the blacksmith when breaking a bar in the cold and readily start cracks in the adjacent metal.

FIG. 5.—SECTION THROUGH EDGE OF FRACTURE, GRAPHITIC CAST IRON UNETCHED × 100.

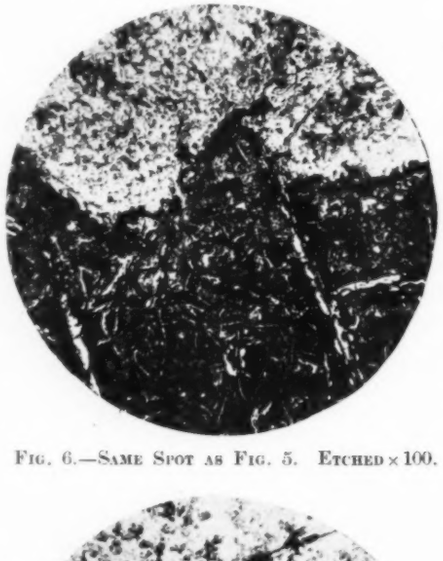

FIG. 6.—SAME SPOT AS FIG. 5. ETCHED × 100.

FIG. 7.—ANOTHER SECTION THROUGH EDGE OF FRACTURE, GRAPHITIC CAST IRON × 100.

Improving the Properties of Cast Iron.

The problem of improving cast iron comes under two headings:—(1) *Graphite*: lowering the amount of graphite and obtainng it in a nodular or rounded form as evenly dispersed as possible, and (2) *metal matrix*: obtaining a matrix of pearlite grains only, that is, one containing approximately ¾ per cent. of combined carbon.

The first and obvious step is to lower the total carbon-content of the metal. Having done that, the cooling changes previously outlined must be controlled so as to leave just the desired amount of carbon in combination. Factors generally recognised as controlling the completeness or otherwise with which these changes take place are:—(1) *Carbon-content*: the more carbon the metal contains, the more difficult will it be to restrain graphitisation. On the other hand, when carbon is as low as 2.0 per cent. it is difficult to get any graphite formed at all; (2) *silicon-content*: every foundryman knows how silicon favours graphitisation; (3) *cooling-rate*: it is unnecessary to dwell upon this point; and (4) *other impurities*: sulphur retards graphitisation, as also does manganese probably in itself, though it exerts a contrary effect in the presence of sulphur until it is over four to five times the amount of the latter element, due to the formation of manganese-sulphide and consequent mutual neutralising action. In general foundry practice sulphur is kept down below 0.12 per cent, and manganese in ratio, silicon being the significant variable.

In recent years Dr. Maurer, of the famous Krupp firm in Germany, has studied the effects of varying carbon and silicon-contents, and evolved a structural diagram reproduced in Fig. 8, which is claimed to hold good for "an ordinary cooling-rate," while the positions of the alloys should be moved to the left for very slow cooling and to the right for very rapid cooling. Field I represents the region of white-irons, II that of the graphite-irons with all-pearlite-matrix, and III the graphitic-irons with a mainly ferritic-matrix. Field II*a* reproduces the mottled irons, and II*b* the pearlite-plus-ferrite irons. This diagram has, it is believed, been used with some success, more particularly on the Continent, as a guide during the development of special quality irons. Perhaps the first significant attempt to improve the structure of foundry-iron was by the addition of steel or wrought-iron scrap in the cupola to give "semi-steel." The name is a misleading one, as any improved qualities obtained by this means are not due to the presence of a special "steel-constituent," so to speak, in the structure of the metal, but to the fact that silicon (also phosphorus) is lowered by dilution, while the average carbon-content as charged is lowered so that good cupola practice can take effect by limiting the amount of carbon picked up in the cupola.

The advantage of steel-additions lies in the fact that they enable the foundryman having proper metallurgical control of his plant to start off with almost any average "as-charged" analysis system desired, and that the carbon present is more thoroughly dissolved in the molten metal. While a powerful weapon in skilled hands, steel-additions become nullified in the absence of some degree of metallurgical control, and may even be a source of trouble.

The Newer Processes.

Several patented processes for the production of high-grade cast iron are based upon the use of steel additions; those of Emmel (British Patent No. 244,405) and Corsalli (British Patent No. 254,727) are examples. Emmel appears to use a metal containing 2.4 to 2.8 per cent. of carbon and about 2.0 per cent. of silicon, and to superheat it. He appears to vary the carbon-content to suit the size of the castings, and claims to do so by controlling the blast pressure. Corsalli, on the other hand, stresses more the cupola design. He claims to use a fairly high blast-pressure with a small proportion of free-oxygen added, this oxidising much of the carbon and most of the silicon and manganese in the metal. These two latter elements in the required amount are added separately in the form of ferro-alloys packed in fusible-containers or coatings which protect them from the unusual oxidising conditions encountered

(*Continued on page* 94)

The Foundry Apprenticeship Problem.

Authoritative Pronouncements at Birmingham Dinner.

The progress and prospects of the Institute of British Foundrymen and other interesting topics were referred to in the speeches at an informal dinner and smoking concert arranged by the Birmingham, Coventry and West Midlands Branch of the Institute, which was held on Saturday, January 19, at the Engineers' Club, Waterloo Street, Birmingham. Mr. F. G. Starr (Branch-President) was in the chair and the speakers included Mr. S. H. Russell (President of the Institute), Mr. T. Makemson (General Secretary) and Mr. A. Harley, of Coventry.

MR. HARLEY, in submitting the toast of the Institute, said the organisation was going ahead. At the meeting that afternoon 76 new members had been passed. What was very gratifying was that the leakage, which in past years had been considerable, was now being checked, so that the addition to the membership would be genuine. Much of the present success he attributed to the President and Secretary. The membership was round about 1,800, but in his opinion it should be nearer 18,000, when they considered that there were approximately 4,000 foundries in Great Britain and the Institute had not one member per foundry. That was an indication of what remained to be done. Most of those interested in the technique of the trade were very disturbed to find how few young people were coming along to learn the trade. He knew what the usual argument was, namely, that methods of production had changed; but the fact remained that mass production required a technique. There were more opportunities to-day for real, live young men in the foundry trade than in any other trade he knew. They wanted young men who would study the job, who would devote themselves to it, and such young fellows were rare in his experience. They got people in the foundry trade who did not seem to trouble to read any of the literature that was published as to what was going on in the trade. The foundry trade would not develop through people of that kind, and he felt that whatever the sub-committee appointed might do to make it possible to draft in young people and give them an interest in their work would be all to the good. It was, however, in his opinion, essential that those foundries which were in a position to do so should exert themselves to establish a proper system of training. There was no service in a young lad going into a foundry and being left to pick up what he could. They were therefore anxious that foundries should take up definite training schemes in conjunction with technical schools. He hoped the progress made by the Institute would continue. They had been fortunate in their presidents for a good many years past, and it seemed probable that Mr. Russell would end the year with the Society in a better position than when his term of office opened. (Applause).

Steel Castings.

THE PRESIDENT OF THE INSTITUTE, in reply, said he attributed the success of the Institute in the main to the efforts of the Secretary, Mr. Makemson, and to the enormous amount of work done in the different branches. The real strength of the Institute was in the branches, and in so far as the branches flourished so would the Institute flourish. Great credit was due to the officers and councils of the branches for the whole-hearted way in which they worked for the interest of their fellow-members and also to the members of the Council of the Institute who turned up in such wonderful numbers every quarter at towns scattered all over England. The Institute was a very democratic body, and he believed much of its success was due to the fact that not only did the officers work, but the whole of the members, and in that way results were achieved.

He wished to draw attention to perhaps the most striking happening for some time in a branch of the Institute, and that was the series of papers which had been presented to the Scottish Branch on steel castings. The main fact that emerged was that the Admiralty, through Engineer-Commander Sidgwick, had made what might be considered almost an official statement that they had decided to encourage in every possible way the use of steel castings. They gave very full, and what probably appeared to them adequate, reasons for their decision. The news was not pleasant to him, but he was not looking at it from his own personal point of view, but from the point of view of the Institute. It appeared from the first paper that the supply of steel castings the Admiralty required could not always be obtained and often many that were obtained were not so good as they wanted. The Commander plainly stated that in his opinion foundrymen had not fully explored the possibilities of their craft in producing steel castings. He even went further and said that for a certain class of casting a better casting could be obtained from the Continent of Europe than could be got in Britain. There was an excellent chance for the Institute to do real, solid service, not only to their own industry, but to the country. It was definitely stated that Great Britain was an importer of steel castings and not an exporter. When they thought of the history of steel in Great Britain that was a serious reflection upon the apparent lack of progress. He was sure the matter would not be allowed to rest where it was. He was also sure that if any co-operative effort was made, either by way of research or in any other direction, the Institute would wholeheartedly back up that movement and that every individual member would do his best to try and put the house in order.

Two Schools of Thought.

As to the lines along which the Institute would ultimately develop, the President said it was obvious that to some extent there were two schools of thought, one of which was extremely anxious to encourage the membership in the Institute of what he might call the journeyman or the craftsman, while the other section was equally anxious to encourage membership among what might be called the executive and scientific side of the foundryman's work, and tending to ignore the journeyman. The really skilled journeyman, the craftsman, was, they all admitted, getting more and more scarce, while the new recruits to the industry were not all of the right type. He believed the provision of free secondary education to many boys was robbing the industry of the cream of the boys. Whereas twenty years ago the children of the more intelligent of the working classes left school at 14 and a big proportion came into the industry, to-day those boys passed an examination, qualified for a scholarship, and became secondary school boys. They were trained until they were 16, and then they could not get them into a foundry. They wanted a clean job; a cuff and collar job. He was a great believer in education, but it had had that unfortunate effect. On the other hand, there had been a really amazing development in what might be called the class of foundry engineers—well-educated and broad-minded men, but frequently men without any real, practical knowledge of moulding. He meant that many of them could not make a mould on their own. But they intelligently applied the metallurgical knowledge which was so readily available; they were very keen on introducing methods of labour-saving, and it would be found that in quite a number of the foundries to-day the executive men, particularly under mass production, had been trained more as mechanical engineers than as foundrymen, and yet they had made very successful managers. He thought it might be claimed that the foundry trade was no longer the Cinderella of the engineering industry. Many of the modern foundries built, the modernisations carried out in older plants, the intelligent thought and work put into the lay-out of foundries, had entirely removed that old sneer.

The Institute's Progress.

MR. MAKEMSON, in proposing the toast of the Birmingham, Coventry and West Midlands Branch, said the present membership of the Institute—1,800—must only touch the fringe of the possible members. There must be many thousands of people in Great Britain who would derive benefit from membership of the Institute. Of course it was urged that the present was not the time to undertake an extension of the membership. But he denied that a subscription to any technical association could be regarded as a luxury. More and more, membership of such associations was becoming a necessity. He contended that it was in lean years of trade that the advantages of the Institute became most pronounced. Much was heard of the prosperity of the great nation on the other side of the Atlantic. He felt convinced that at least some part of that industrial prosperity was due to the wide interest taken in that country in professional and trade organisations. In Birmingham and the neighbourhood there was a great field for membership extension.

The question of apprentices becomes more important every year. More and more the question was asked: "Where is the next generation of skilled foundrymen coming from?" and at the same time there were other people saying that the foundry trade was not the trade into which to apprentice a boy. Obviously, one of these ideas must be wrong, and personally he believed it was the second idea that was wrong. He was quite convinced that the foundry trade offered a very fine opportunity to the right type of apprentice—to the secondary school type of boy. There was going to be in future, and there was to-day, a demand for practical foundrymen with some technical education—for the educated practical foundryman. The man who was purely a technical man would on the whole not be quite a success. On the other hand, the old-time thoroughly practical man, in many cases almost illiterate—he was afraid his day also, as a force in the foundry industry, was past. The future was for the practical man, but the educated practical man. The secondary school boy, who was not afraid to take his coat off, was going to have his opportunity. The training of these people, when they came into the foundry, was a matter of some concern. It was a matter to which the Institute was giving a great deal of thought, but the more they thought of it the more complicated and difficult the problem became. It was definitely at the forefront of the Institute's policy, and if the problem was not entirely solved at any rate something would be done towards its solution. At Birmingham, in common with some other branches, they had done something towards interesting apprentices in the technical side of the trade by the establishment of a Junior Section. The Junior Sections, of course, would not take the place of training in a technical class. It was impossible to learn on one night a month what would be learnt on three nights a week. On the other hand, the Junior Section enabled apprentices to take a wider view of their trade than would be possible if their experience were confined to their own foundry. They realised how much there was to learn, and that was an important point. Many foundry apprentices did not realise how vast and wide the trade was. Very often the reason why they did not attend classes and take an interest in the trade was because they did not know how great was the interest of the trade. He believed that the Junior Sections were accomplishing that work; the work that they set out to perform was being carried out. There was no better work that they could do than to look after the coming generation of foundrymen by taking a practical and real interest in the Junior Sections. They in Birmingham were to be commended for being one of the branches which was carrying out work in this direction.

MR. STARR acknowledged the toast.

AT A MEETING of the East Midland sub-section of the Institution of Engineers, held at the Derby Technical College on January 5, Mr. F. H. Rosencrants gave an interesting address on "Practice and Progress in the Combustion of Coal as applied to Steam Generation," illustrating it with several lantern slides. Mr. G. A. Brearley, of Loughborough, presided.

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Middlesbrough as a Foundry Centre.

A meeting of the Middlesbrough Branch of the Institute of British Foundrymen was held at the Cleveland Technical Institute, Middlesbrough, on Friday, January 18, when Mr. S. V. Toy delivered his presidential address, in the course of which Mr. Toy said:—

Mr. Wilson and Gentlemen,—It gives me great pleasure to be in the proud position of addressing you as President of the Middlesbrough Branch of British Foundrymen.

The inception of this Branch I consider to be of the greatest importance to the advancement of Middlesbrough foundry practice, and although one of the first to help it at the start I very much regret that I have been unable to devote the time and work necessary to help to keep the movement in action as a lively and active going concern. This inability has, unfortunately, been intensified during my term of office, and I would gladly have stood down in deference to the claims of other members whom I felt sure could do more justice to the furtherance of our progress, but as your Council still desired me to accept office, I therefore considered that the responsibility rests to some extent on your own shoulders.

The 1930 Convention.

Our very best thanks are due to Mr. Wilson and Mr. Ridsdale, and the members of Council, for their most valuable and active guidance through our first few years, and I do not think that any further tribute to Mr. Wilson's personality could be paid than the General Council's appointment of him to the position of vice-president. We all know the many qualities which have so early gained him that distinction, and I am sure that he will receive our very best wishes and support during his term of office as president of the British Foundrymen, which term, I understand, corresponds with their proposed visit to Middlesbrough in 1930.

It is quite likely, in the same year, we may be lucky enough to be presided over by Mr. William Shaw, who, as you all know, introduced into this district the most successful foundry in producing steel castings.

I am sure with these two gentlemen in office we ought to show the rest of the Branches that Middlesbrough, in spite of its infancy, can submit a programme quite as attractive as, if not superior to those which have gone before.

Local Conditions Satisfactory.

We had a splendid beginning with a total membership of 66. Unfortunately, however, we have not made much progress since; in fact, our membership at the present time shows a slight decrease, our numbers having dropped to 61. There are still a large number of foundries and foundrymen who have not yet favoured us with their support, and we must all endeavour to bring in new blood, without which we shall in the near future be faced with difficulties of finance, making our continued existence very doubtful.

I understand that Dr. Ingall intends to make foundry practice one of the features of the wonderful new Technical College. This will be a most valuable asset in training the young foundrymen, helping, I hope, to stimulate the imagination of our moulders and other foundry workers who, I consider, are sadly lacking in modern improved methods through no fault of their own.

Continental Competition.

How is it that our competitors on the Continent can deliver castings into this country at prices considerably below our costs? This cannot be wholly due to lower wages cost, and in many cases they are forced to buy their raw material, in the form of pig-iron, even from this district. There must be other reasons.

To my mind their methods and organisation must in many cases be superior to ours. Quite recently I was fortunate to be able to spend some considerable time in a moderate size foundry on the Continent, which was turning out up to 150 tons of steel castings per week, all of which were made in green-sand moulds. Surely there is plenty of scope even here in our foundries to cultivate this class of moulding more widely. At the present time, to a large extent, the mention of green sand implies scabs, blow holes, etc.

Extending Industries.

It is very gratifying to hear of new enterprises in the casting trade in our immediate neighbourhood. Strangely enough when anyone has been bold enough to venture on increasing our output of castings on Tees-side it has nearly always taken the form of producing types of castings which are already in production, thereby introducing further competition.

There are possibilities for a foundry producing malleable or light iron or light steel castings to exist, but, unfortunately, the light engineering trades have not gained sufficient foothold in this district to create such an outlet. What the foundryman would like is first of all the introduction of these engineering shops. The cause of the depression we have experienced, and are still experiencing, is due no doubt to our dependency on the heavy trade, such as rolling mills, bridge works, marine engines, etc. The motor trade, and with it such a variety of special irons and steels, surely need not have been confined to the Midlands, and we must congratulate one firm at least in turning its attention to capturing a share of the cylinder castings in this connection.

There is one special point which I should like to mention in relation to our meetings. They do help to bring together those people who supply the brains and those who supply the brawn. The modern tendency of foundry practice is to lessen the hard manual labour by the substitution of all types of labour-saving devices driven by power, the object of which is the all-important aim of lessening the cost of wages per ton of castings produced. Wherever machinery is installed for this purpose it does not necessarily imply that all labour is eliminated. These machines are required to be kept in operation by mental labour, which is more fatiguing. Therefore, lectures such as we have been favoured with at our meetings should be of great value, not only to the men in charge but also to those who have the practical operation of the machinery under their control, in that they tend to stimulate the mental activity.

Electric Furnace Practice.

The first electric furnace for use in steel-making was designed in 1879, strangely enough, by the late Sir William Siemens, whose name is universally known in connection with the open-hearth process. This electric furnace consisted of an ordinary size crucible, the sides of which were pierced by two carbon electrodes. The heat was generated on the same principle as an ordinary arc lamp, by moving the electrodes towards each other until a constant arc was generated. After a few years of apparent stagnation the question was taken up by an Italian, and the Stassano furnace was patented in 1898. This time the object was to produce steel direct from the ore in one operation. The whole project was a complete commercial failure. Incidentally, after all these years there has been running for quite a long time in Sweden an electric blast furnace, which has a similar object in view, and which, I think, is proving fairly successful in the manufacture of special steels.

Following the failure of his direct process Stassano was more successful with an arc furnace for producing steel from scrap. In this he had three electrodes penetrating the sides of the furnace and arcing with each other a few inches above the slag line. He also had an ingenious idea of rocking the whole furnace, the object being to obtain uniformity of heat, and also keep the steel circulating in contact with the slag as much as possible.

Modern electric furnaces may be divided into four distinct classes—the induction furnace, the high frequency induction furnace, the arc furnace, and the arc resistance furnace.

The induction furnace is really a transformer, the current being induced in the bath of metal which takes the place of a secondary winding. Being composed of large coils and windings it is very cumbersome in comparison with the weight of metal which it can melt, and, consequently, has not found any use in this country, although one or two operate successfully on the Continent.

The arc furnace has been supplanted by the arc resistance furnace. The principle of heat generation being arcs produced from the points of carbon electrodes immediately above the level of the slag, and the current passing through the slag and metal returns via one or more of the electrodes to the source of supply.

Electric Alloy Steel.

We have had lecturers from Sheffield who have always favoured us with their good-humoured remarks on the inability of Middlesbrough to make good steel. Although not exactly steel makers to any big degree, we have always attempted to produce steel of better quality in the form of alloy steel. Recently we have made several tons of stainless iron and also austenitic nickel chrome steel for acid-resisting purposes. From these we have had various sections rolled and some run into castings. The casting of the steel has been very successful, the greatest difficulty being in getting the rolling mills sufficiently interested to carry out the careful rolling and after-treatment required. I mention this, not as a means to advertisement, but purely a local interest, and have here one or two sections and castings which you may carefully examine afterwards. I shall only be too glad to give you any further information when we have been able to accumulate more data.

Trade Outlook.

Returning to a more general subject, last year has been a very critical one in the history of the iron and steel trade. There are certain vital facts which have made themselves manifest. A large percentage of works are undoubtedly out of date and inefficient from the point of view of meeting the quality and output demanded by modern conditions, due in many cases to lack of capital. Other works with capital are sadly lacking in initiative. Heavy rates and transport charges have helped to make successful competition with the Continent impossible, where the lower costs are made possible by lower wages and consequent worse conditions of labour.

What we should like to see is the foreign and coastwise shipments of pig-iron from Middlesbrough reach the pre-war total of one and a-quarter million tons, as against last year's total of, say, less than a quarter of a million tons, and our national shipbuilding output reach a tonnage launched per annum of one and a-half million tons, as against approximately one million tons for the year just ended. When we reach these figures the coal trade depression will in all probability have passed.

Although help can be given by the Government to alleviate the present position, the problem is beyond any individual, and will best solve itself. The rise in wages on the Continent, the grouping of our larger industries and standardisation, will undoubtedly play a big part. Personally I look to the present co-operation of employers and employees. All people directly concerned in production, brains and brawn, must meet together with goodwill.

Light Castings Dispute.

At a largely attended meeting, held in Falkirk on January 23, proposals for an early termination of the strike of rain-water moulders, which has been in progress since the beginning of the year, were considered. The employers and the representatives of the Trade Unions have agreed to recommend the acceptance of new terms. The original demand of the employers was for a five per cent. reduction in wages. The new proposals put forward by the National Light Castings Federation are that 2½ per cent. reduction on the wages bonus be made on the men returning to work, a further 2½ per cent. three months later, and that wages then be stabilised until the end of the year. The meeting after prolonged discussion unanimously agreed to take another ballot to secure a verdict for or against the acceptance of the new terms, provided the workers in other areas are prepared to act in the same manner.

Aluminium-Silicon Alloys: Their Properties and Some Application.

By R. B. Deeley, B.Sc., A.R.S.M.

PART II.—APPLICATIONS.

(*Continued from page 51.*)

Fig. 15 shows a pair of sliding doors for coaches of the Bombay Baroda and Central India Railway on a test slide. These doors were made in very large quantities and are cast flat, part machined, bent to the curve at the bottom, and then finally machined, and fitted with guides, wheels, locks, window frames, etc.

Fig. 16 shows the coach in which these three doors are fitted. These photographs show castings which are over 6 ft. in length and about 2 ft. 6 in. wide. The stiles down them are approximately 1-in. square and the panel is $\frac{1}{8}$-in. in thickness.

Fig. 17 shows the bottom portion of a door cast in 3 L.11 alloy, from the same pattern as that used for the doors in Fig. 14, and illustrates how difficult it is to make a satisfactory casting from a pattern of this type in an alloy other than modified aluminium silicon. The other B.E.S.A. alloys give similar results to 3 L.11. This particular casting was made at as low a temperature as possible in order to avoid excessive shrinkage, and it will be seen from the mis-run in the middle of the left-hand panel that the casting temperature was, at any rate, not too high. Even so, the cracks through the lock section across the top and bottom, and down the sides of the panel below the door, illustrate how difficult it is to use these other alloys for this type of casting.

Fig. 18 shows one of the latest types of sliding doors pneumatically operated, as fitted on the London Electric Railway. This design is the first in which a door has no centre rib vertically down the panels.

Fig. 19 illustrates another application of the modified aluminium silicon alloys, in which castings from them have replaced wood or steel pressings. The frame in the photograph is for a cross seat in electric underground coach.

Another replacement of wood by "Alpax" is shown in Fig. 20, which is a photograph of a rising and falling light frame, the casting of which weighs 6 lb. 2 oz., and when fitted with glass weighs 14½ lbs. This *Die* casting is an excellent example of the freedom from hot shortness and of the fluidity of the aluminium silicon alloys, for the frame is of "H" section and each limb of the "H" is $\frac{1}{8}$ in. thick, although it is 3 in. wide.

A still better example of the same properties is shown in Fig. 21, which is a body side light frame for the Egyptian State Railways. This frame has a rebate at one side, and a number of these frames fitted together make the whole side of the coach from the waist level to the underside of the roof, thereby providing the windows. This casting also is ¼ in. thick in all sections, and as can be seen from the photograph is of particularly large area in comparison with the thickness. *This, it is thought, must have the largest surface area of any aluminium alloy gravity die casting ever made.*

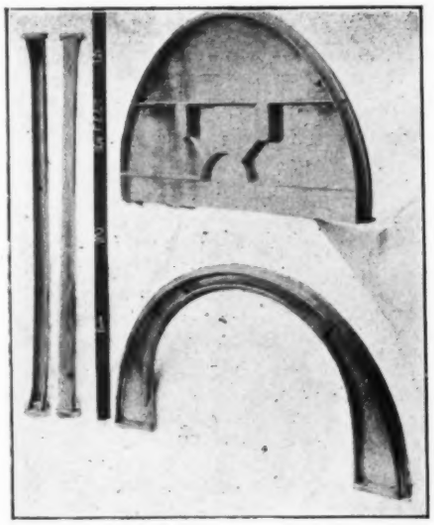


FIG. 22.—DASHBOARDS AND STRUTS, CAST IN ALPAX AND FITTED TO THE FAMOUS BLUEBIRD RACING CAR.

Fig. 22 shows the two dashboards and struts which were cast in "Alpax" and fitted to the "Bluebird," the Napier-Campbell racing car, in which Capt. Malcolm Campbell made a world speed record in the United States.

An example of another type of application of aluminium silicon alloys is given in Fig. 23, which is a motor gear case for use with electric traction motors, as fitted on the London Electric Railways. This weighs, as cast, 63 lbs. and has replaced malleable iron owing to its reducing unsprung weight.

Fig. 24 shows a peculiar application of "Alpax" in aircraft works. This scroll is *die* cast in one piece, and it consists of three whorls in thickness ¼ in., and is another excellent example of the fluidity and freedom from hot-shortness of this alloy.

Fig. 25 shows a radiator for an electric refrigerator and weighs as cast 18½ lbs. In this particular instances an "Alpax" *die* casting was chosen on account of its superior resistance to corrosion, and also the cheapened production possible with castings in an alloy of such peculiar foundry characteristics.

Fig. 26 is a view of a part of the "Bluebird" racing car, showing the dashboards and struts shown in Fig. 22 in position on the car.

Fig. 27 shows side pillar members used in the construction of char-a-banc bodies.

Fig. 28 shows another application of one-piece cast doors in modified aluminium-silicon alloy. The door shown on the omnibus photograph was cast flat, and bent to the large radius necessary by the curve of the lower side of the body.

Fig. 29 shows a fan impeller, a large number of which have been made and have withstood atmospheric corrosion with entire satisfaction.

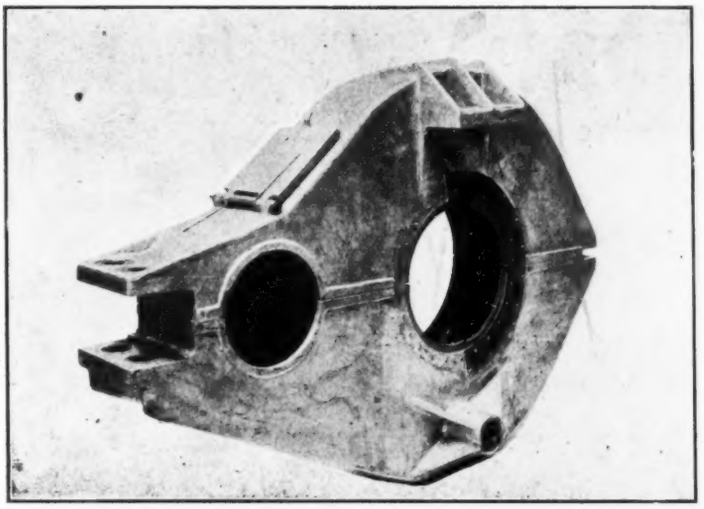


FIG. 23.—A MOTOR GEAR CASE WHICH HAS REPLACED MALLEABLE CAST IRON OWING TO ITS REDUCING OF SPRING WEIGHT.

DISCUSSION.

The CHAIRMAN (Mr. W. B. Lake, J.P.), inviting discussion, paid a tribute to Mr. Deeley for his very carefully prepared and informative Paper, which, he added, reflected great credit upon the Institute of Metals and the Institute of British Foundrymen (both of which societies Mr. Deeley is a member).

Difficulties with Pattern Plates.

MR. C. H. KAIN, referring to modification, said he gathered that the modified condition did not persist after re-melting, even if the heat consisted wholly of re-melt. He asked if, in the casting of aluminium-silicon alloys, there was a

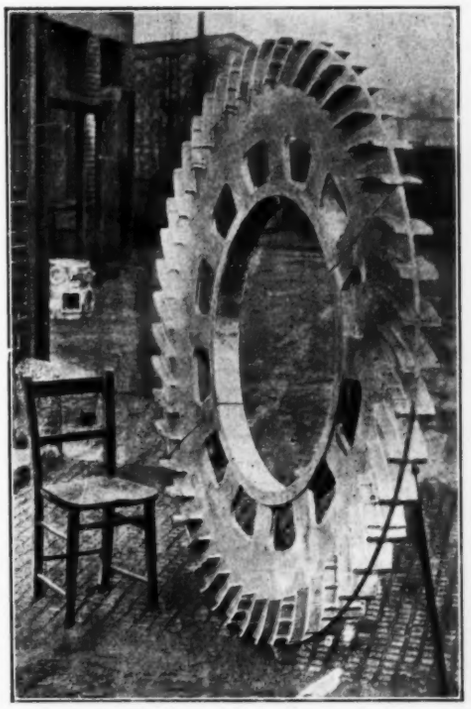


FIG. 29.—A FAN-IMPELLER CAST IN ALPAX TO WITHSTAND CORROSION.

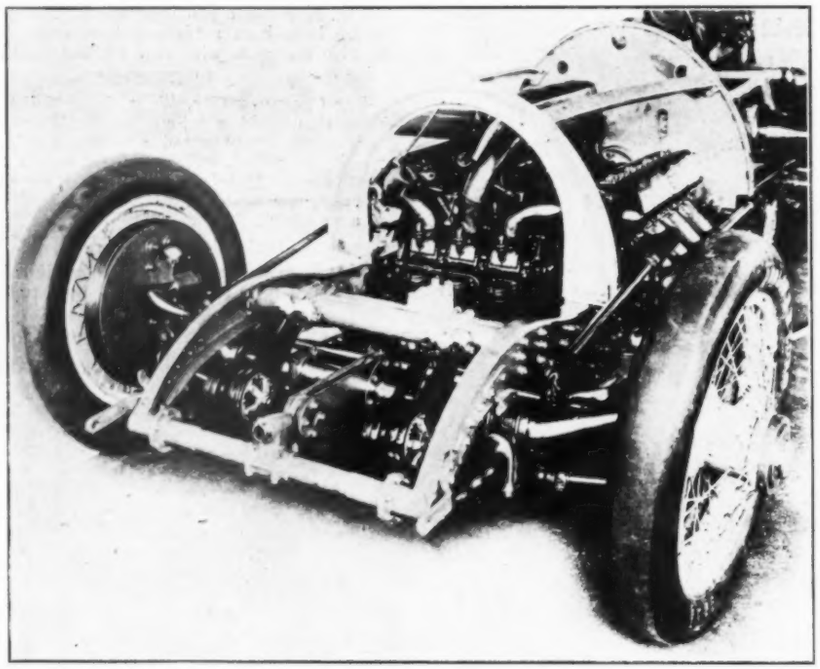


FIG. 26.—*The famous "Bluebird" racing car showing castings made from Alpax in position.*

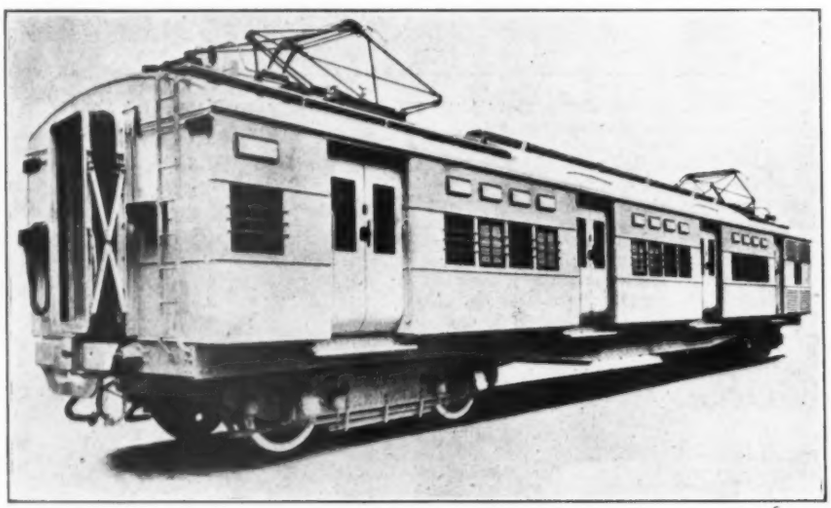


FIG. 16.—*A coach into which the doors, shown in Fig. 15, which are 2 ft. 6 ins. wide by 6 ft. high, are fitted.*

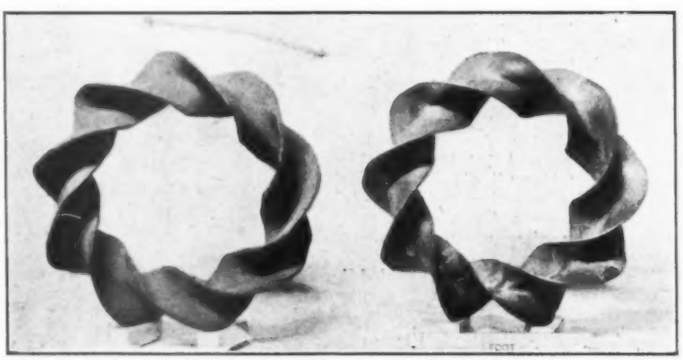


FIG. 24 *is an interesting example of die casting.*

Aluminium Silicon Alloys

FIG. 27.—*Side pillar-members used in the construction of charabancs.*

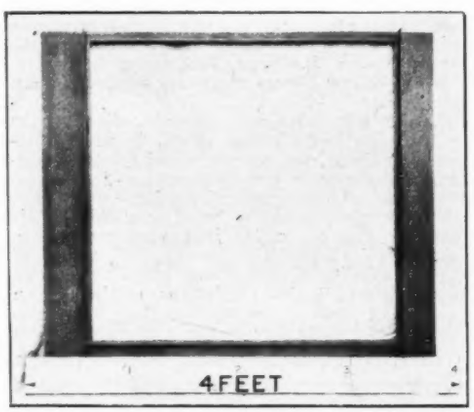


FIG. 21.—*An extremely large die-casting, taking the form of a window frame for the Egyptian State Railways.*

FIG. 19.—*These castings have replaced wood or steel pressings. They are used for cross-seats in the Underground coaches.*

lloys Their Properties and Some Application.

FIG. 28.—*Motor Omnibus carrying bent Alpax castings.*

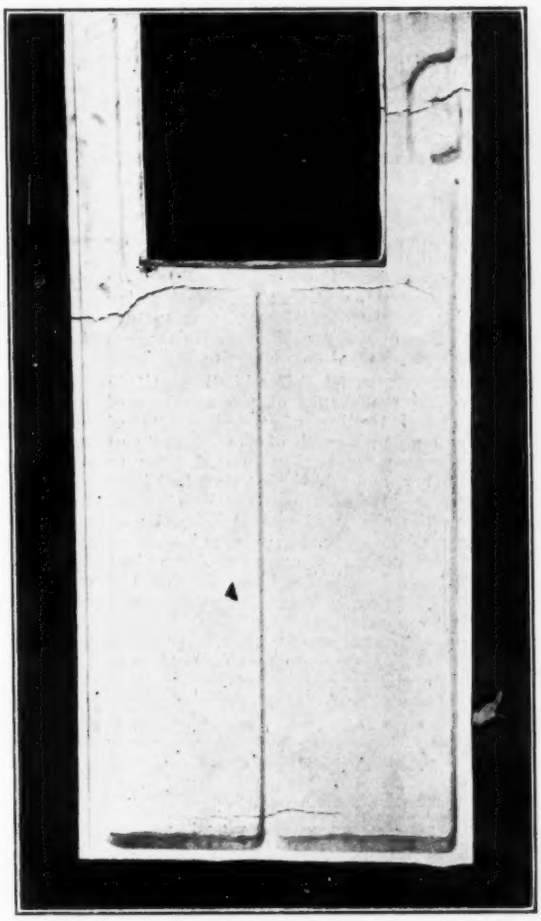


FIG. 17.—*Shows the results of casting the doors shown in Fig 15 in 3 L.11 Alloy. Note the serious cracks.*

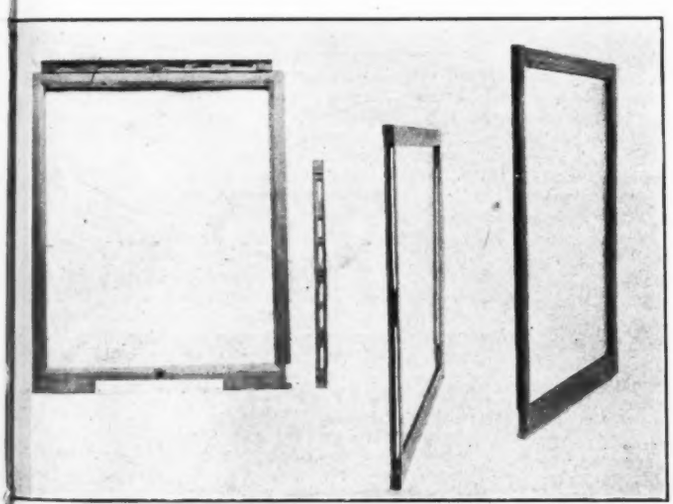


FIG 20.—*Is an excellent example of a die casting made in Alpax.*

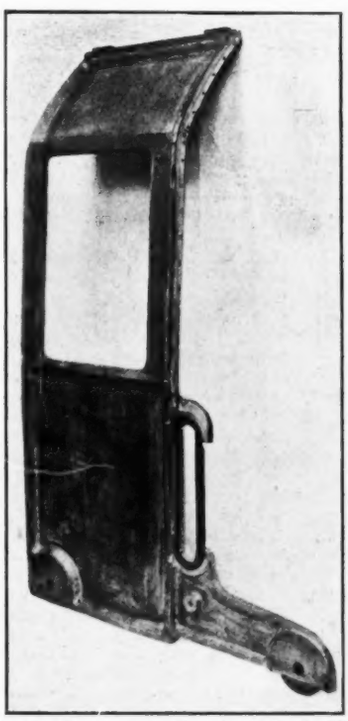


FIG. 18.—*Doors made in Alpax for the London Electric Railway. Note the absence of a vertical centre rib.*

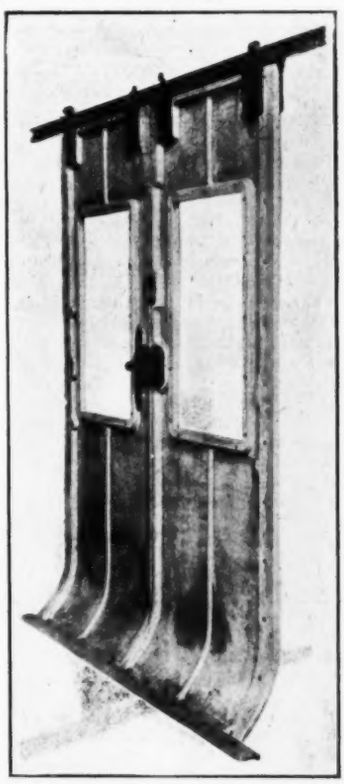
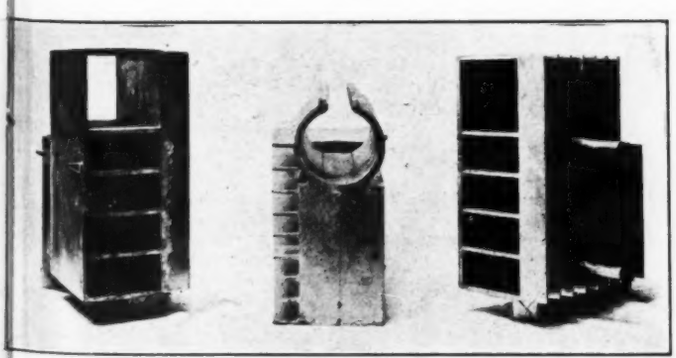


FIG. 15.—*A pair of sliding doors for a coach built for the Bombay Baroda Central India Railway.*



IG. 25.—*Refrigerator die-casting made from Alpax, because of its high resistance to corrosion.*

lag between the metal and the mould. His company had experienced some little difficulty in making a certain small casting of this alloy. The casting was perfectly simple, being a plate, 12 in. by 3 in., and about ¼ in. thick, with a boss running across it. When they had made such plates a large sink had occurred near the boss, due to shrinkage, and this difficulty was not overcome, although the plates had been cast in every possible manner, and at temperatures varying from 570 to 710 deg. C. Subsequently, similar plates were bought from an aluminium-founder, and, although there was a shrink near the boss and in the boss itself, the outsides of the plates conformed perfectly to the dimensions of the mould. This seemed to suggest that the castings adhered to the sides of the mould, and that some sort of lag obtained under certain conditions of temperature and casting. He asked for Mr. Deeley's views on that problem.

PROFESSOR T. TURNER (Past-President, Institute of Metals) voiced the thanks of the members of the London Local Section of the Institute of Metals to the London Branch of the Institute of British Foundrymen for having invited them to attend the meeting, and added that they had been very glad to come. He congratulated Mr. Deeley, not only upon the choice of matter he had presented to the meeting, but also upon the form of presentation. Some years ago Dr. Voce had carried out experiments in his laboratory on the problem of modification, and, so far as he could judge, the statements made by Mr. Deeley in his Paper were in accordance with their experience. The development of the application of the aluminium-silicon alloys was very interesting. He had had no idea—although, perhaps, one ought to expect it—that carriage doors and other castings of relatively large size and of such thin section had been made with these alloys.

Resisting Acid Attack.

MR. W. T. HOBKIRK asked Mr. Deeley for information as to the ability of the aluminium-silicon alloys to withstand the attack of acids which might be present in water. This was interesting from the point of view of the production of radiators for export. Radiators are made of aluminium in this country, but he pointed out that the water supplied here is, practically speaking, pure, whereas the water used in radiators exported to other countries might not be so pure.

Inadequate Nomenclature.

MR. J. D. GROGAN said that the whole question of modification was extraordinarily interesting, and it was also extremely humiliating to the ordinary scientist, because it was analogous, he considered, to what an insurance man would call an "act of God." In the present state of knowledge, no scientist could really explain it satisfactorily, but perhaps that was all to the good, because it made them realise that they are not yet on the road to knowing everything. The use of the term "grain refining" in connection with modification was rather dangerous, he suggested, because metallurgists generally spoke of grains as meaning "crystal grains." The term "grain refining" suggested that the crystals, instead of being large, became small on modification, but that was not altogether the case; it was quite possible that the size of the crystals was reduced, but the reduction was not really very much. It was the eutectic structure inside the grain that was refined. If someone could suggest another phrase to describe this phenomenon the danger of misunderstanding would be avoided. Another excellent quality of the silicon-aluminium-alloy, and one which Mr. Deeley had not mentioned, was that when it was cast in metal moulds with a suitable dressing it had a fine surface finish. On the other hand, Mr. Deeley had emphasised the pitfalls into which novices had fallen when founding aluminium-silicon alloys, and it could not be stressed too often that the founding of them presented special difficulties to founders who approached the task with a knowledge of the ordinary aluminium alloy castings. One must have a knowledge of the difficulties and of the methods to be applied to overcome them.

Remelting Necessitates Remodifying.

MR. DEELEY, discussing the difficulties experienced by Mr. Kain in the casting of aluminium-silicon alloy plates, said he imagined that there must have been something wrong with the design of the moulds, and that the runners and risers were not arranged to feed the castings properly.

MR. KAIN said he did not think that was the cause of the trouble, because castings which were correct and castings which were not correct were all made in exactly similar moulds, and, as far as he knew, under the same conditions.

MR. DEELEY asked if the same metal was used in each case.

MR. KAIN replied that, so far as he knew, it was.

MR. DEELEY asked if the metal were modified.

MR. KAIN said that the metal he had used was not modified; whether or not the metal used by the aluminium founders who had made some of the plates was modified he did not know. Although there was a very large shrink in the heavier section of the good castings, in the thinner sections adjoining the heavier section the castings conformed exactly to the shape of the mould. In the castings he had made the thickness was less than that of the mould.

MR. DEELEY said it was rather difficult for him to help without seeing the castings and without knowing definitely whether or not the alloy was modified. Replying to the question as to the effect of the modifier after re-melting, he said it had not the same effect after re-melting as it had previously; the alloy must be modified each time.

Replying to Mr. Hobkirk, he said it was difficult to say how the aluminium-silicon alloys would withstand the action of acids unless one knew the exact conditions, but the silicon alloys were less liable to corrosion in general than were the alloys containing copper and zinc. Erosion, of course, had a great influence in the removal of material.

Like Mr. Grogan, he had had difficulty in expressing the effect of modification, and the only term he could think of was "grain-refining," applying it in the wider sense. After all, the phenomenon was a type of grain refining, but he admitted that there was great liability to confusion with the meaning of the term as generally understood, i.e., the refining of the whole crystal. The finish of the silicon alloys as a general rule was particularly good.

Vote of Thanks.

DR. S. W. SMITH proposed a vote of thanks to Mr. Deeley for his Paper, and also took the opportunity of endorsing Professor Turner's expression of appreciation, on behalf of the members of the Institute of Metals, of the invitation to attend the meeting, and of the great pleasure it gave them to be present. Mr. Deeley's Paper was one of profound interest to all concerned with the casting of metals, and the development of the aluminium-silicon-alloys was perhaps one of the most remarkable developments in connection with alloys in recent years. A remarkable feature was that the particular range of alloys dealt with by Mr. Deeley was in the neighbourhood of the eutectic, for, in the past, the eutectic range had been regarded as one to be avoided. The remarkable fluidity of the metal was another important factor which made it possible to produce castings of thin section. An outstanding feature of the process of so-called "modification" was the extraordinary way in which the silicon was finally dispersed in the solid metal. A great deal of significance attached, he thought, to the work carried out by Dr. Gayler, at the National Physical Laboratory, on the effect of "under-cooling" of aluminium-silicon and other aluminium alloys, and he felt sure that had time permitted Mr. Deeley would have referred to this work. Dr. Gayler had shown that the solubility curves produced by supercooling the "normal" alloys were practically identical with the solubility curves produced by the "modified" alloys. It seemed, therefore, as though the process of "modification" resulted in "catching" the alloy, as it were, in an undercooled condition and retaining it in that condition, because Dr. Gayler had found that it was impossible to undercool these "modified" alloys. Very little knowledge of the mechanism of the phenomenon was yet available, but he had no doubt that in a very short time we should understand the process of modification, which should be of great significance not only in relation to these particular aluminium-silicon alloys but also in relation to a wide range of other alloys.

Co-operation Stressed.

MR. H. C. DEWS (seconding the vote of thanks) said the meeting had listened to a most admirable presentation of a mass of very suitably correlated data. Mr. Deeley, bearing in mind the character of the meeting he was to address, had managed to incorporate into his lecture a very suitable blend of theory and practice. It was popularly supposed that the members of the Institute of Metals were immersed in theory, and that the foundrymen were wallowing in practice. Those who were members of both bodies would agree that such a conception was an entirely unsuitable representation of the aims of the two bodies. Those who, like himself, found it necessary to keep in touch with the activities of both bodies were very gravely disappointed to find that their London meetings were being held on the same evening in each month throughout the present session, and he—supported by a number of those who belonged to both bodies—would have no hesitation in condemning very seriously any movement which sought to separate the interests of the two. As a member of the Council of the London Branch of the Institute of British Foundrymen, he would do his best to ensure that such a catastrophe as had occurred this session would be avoided.

The vote of thanks was carried with acclamation.

MR. DEELEY, in a brief response, apologised for having omitted to refer to the work of Dr. Gayler, but, as Dr. Smith had suggested, the omission was due to the necessary limitation of the time at his disposal.

THE CHAIRMAN, referring to Mr. Dews' remarks as to the necessity for avoiding the holding of meetings of the two bodies concurrently, said that both Dr. Smith and himself appreciated its importance, and had already pledged themselves, on behalf of their respective Councils, to do all in their power to prevent clashing of meetings in the future.

Foundry Labour Dispute.

Messrs. J. & R. Ritchie have closed down their Acklam Foundry, Middlesbrough, on account of the strike of a portion of their employees. They have cancelled orders amounting to £2,000, and it is anticipated that a similar course will have to be adopted in connection with other contracts. Mr. R. Ritchie, discussing the position, observed it was very unfortunate that, although they had kept the foundry working during the depression, they were having to close down, owing to a strike, when trade prospects were improving.

"When the men make up their minds to return, no matter on what terms, we shall be in a position to employ only half their number," added Mr. Ritchie. "The remainder will have to wait until we have orders."

As a result of a national dispute, concerning a 5 per cent. reduction in wages, 100 pipe and connection moulders did not resume work after the New Year holidays, and a further 150 men, not directly concerned in the dispute, are thrown out of work owing to the closing of the works.

Clydeside Engineering Prospects.

The Clyde District officials of the Amalgamated Engineering Union, in their latest report, state that the prospects for 1929 are not unsatisfactory, and that they confidently predict that the industrial situation will be considerably better than 1928.

THE J. R. WOOD SUPPLY COMPANY, 913, Broadway, Cincinnati, has been appointed agent in the Cincinnati district for William Jessop & Sons, Limited, Sheffield, makers of special alloy and tool steels.

Automatic Blast-Gate Control for Cupolas.*

By H. V. Crawford.

(*Continued from page* 66.)

Method of Control.

From the previous instalment it must be admitted that the best results in the melting operation depend not only on having the weight of iron and coke under complete control but also the weight of air. Therefore, the next step is to introduce an apparatus and a method of controlling the weight of air supplied to the cupola.

FIG. 2.—HAND-OPERATED BLAST-GATE.

The company with which the writer is connected has developed a certain electrical control system which is connected with the cable supplying current to an electric motor operating a centrifugal compressor with characteristics suitable for this purpose. This control operates an artificial restriction, Fig. 2, placed in the pipe between the blower and the cupola. This compensates for changes in cupola restriction, as well as for changes in atmospheric conditions, so as to maintain a constant weight of air flowing at all times. Any change in the resistance to flow through the cupola, the atmospheric temperature, or pressure, is automatically compensated for, so as to maintain the same weight of air per minute, regardless of the changes mentioned.

Control Equipment.

The electrical-control system previously mentioned operates on the principle that a blower and motor of suitable type have such characteristics that constant weight of air is delivered when the electrical input in kilowatts is maintained constant. The apparatus consists of a blast-gate which supplies an artificial restriction in the line, which is so manipulated as to give the motor input the desired constant value. This may be manipulated by hand on the basis of use of an ordinary meter, Fig. 3, and hand blast-gate, Fig. 2, or automatically by a mechanism which thereby eliminates the personal equation.

The apparatus is to be actuated primarily by the power input to the motor. However, in ordinary cases, voltage is fairly constant, so that the current reading in amperes varies directly with the kilowatts input. This ampere reading may, therefore, be used in most cases instead of the kilowatt reading. The automatic control equipment, Fig. 4, consists of a reversing motor geared to a blast-gate, and with a large gear-ratio and provided with limit switches to prevent the gate from over travelling and jamming. The control panel mounts an ordinary contact-making ammeter with an indicating-ammeter calibrated in pounds of air, switch and fuse, regulating rheostat and three standard contactors.

When the current increases slightly, contact is made and the circuit is completed through one of the contactor coils. The contactor closes and supplies power to the small motor rated at approximately 1/25 h.p., causing it to run in the proper direction to close the blast-gate, bringing the current down to normal again. Likewise, when the current falls slightly, the other contactor closes, running the motor in the other direction, thereby opening the gate and bringing the current up to normal again.

The third contactor is energised all the time the blower motor is running, and power for operating the panel is supplied through its contacts. When the blower is shut down at the end of the heat this contactor drops out and an anxiliary contact closes the power circuit to the panel, so that power flows direct to the closing contactor and the gate moves to the closed position and the limit switch on the gate breaks the circuit. This means

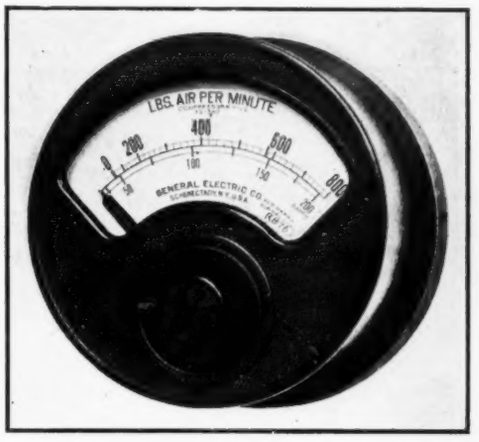


FIG. 3.—METER CALIBRATED IN LBS. OF AIR PER MINUTE.

that the blast-gate is always in the closed position at starting, which gives the best starting condition and also serves to automatically close the gate and prevent the gases from the cupola backing up into the pipe-line and compressor-casing and thereby eliminates the probability of an explosion.

The rheostat is used to vary the reading of the ammeter so that any desired value of pounds of air can be maintained within the limits of the blower, which is approximately from 20 per cent. of normal load to 20 per cent. overload. The contact-making ammeter-arm is adjusted to the horizontal position by screws and a spring, and for a given current, corresponding to the normal current on the machine, with the rheostat in approximately mid-position and in parallel with the coil on the contact-making ammeter, the arm will float

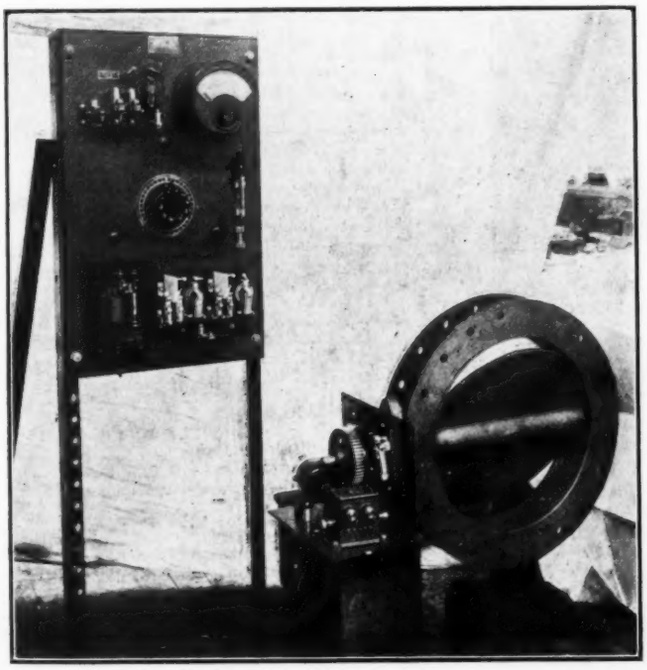


FIG. 4.—AUTOMATIC GATE AND CONTROL-PANEL.

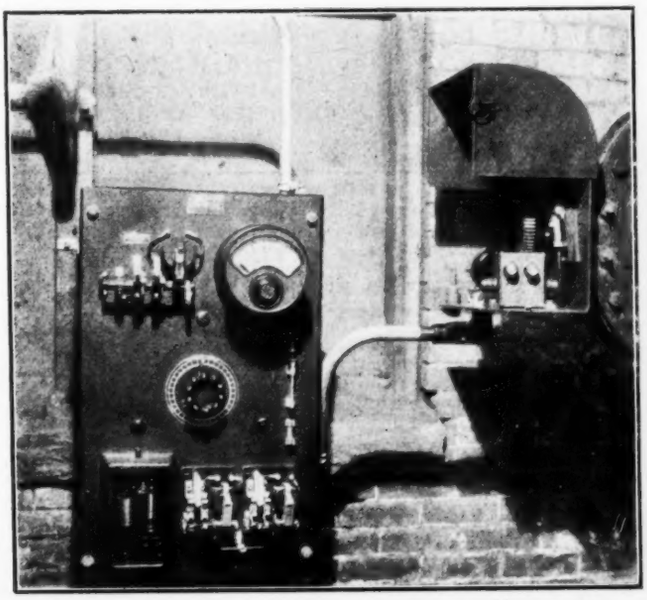


FIG. 5.—INSTALLATION OF AUTOMATIC CONTROL EQUIPMENT.

in this position with both contacts open. If the current or pounds of air value is to be increased, some of the resistance is cut out, allowing more current to flow through the rheostat and less through the current-coil. This causes one of the contacts on the arm to close and the blast-gate is opened wider, increasing the flow of air. The increased flow of air increases the current to a value which causes the contact to open, and the arm returns to the horizontal position. The new value of current and the corresponding new weight of air are registered on the indicating-ammeter. To reduce the weight of air, the rheostat-handle is turned in the opposite direction and the resistance increased. This causes the other contact on the arm to close, and the gate closes and reduces the weight of air to the lower value required.

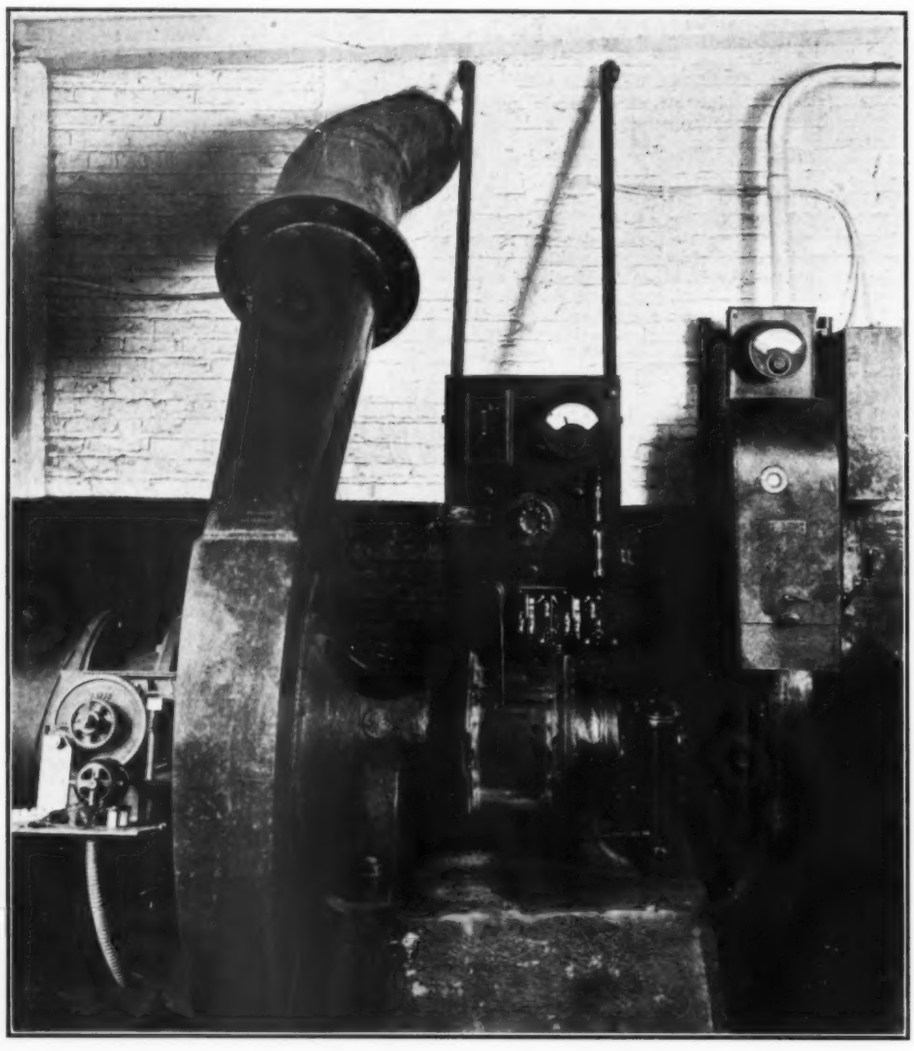


FIG. 6.—INSTALLATION OF COMPLETE BLOWING EQUIPMENT, INCLUDING BLOWER, AUTOMATIC CONTROL, AND HAND-STARTER FOR BLOWER-MOTOR.

The equipment is made of standard parts properly enclosed, and requires no attention other than oiling of the small motor and gears probably once or twice a year. Fig. 5 shows an installation of one of the control-panels and gates, and Fig. 6 illustrates a complete installation of blower, motor-driven blast-gate, automatic-panel and hand-starter for the blower-motor. In Fig. 9 an installation of a complete equipment with special testing apparatus is shown.

Blower Characteristics.

The control-equipment just described is only suitable for use with blowers having certain characteristics. Fig. 7 indicates the characteristics of such a blower, and it can be shown from this figure that constant kw. input or constant current will give constant weight of air.

Assuming for a certain condition that 7,000 cub. ft. is required at 60 deg. F. and 14.7 lbs. barometer to give the proper weight of oxygen, when the air temperature increases to 100 deg. F., this 7,000 cub. ft. will expand, so that the volume of inlet air should be increased in order to get the same weight of air. The weight of the air will vary inversely with the absolute temperature of the air, so that we have $\frac{560}{520} \times 7{,}000 = 7{,}550$ cub. ft. of air to give the same weight of air. Likewise, when the air temperature drops to 0 deg. F., it gives $\frac{460}{520} \times 7{,}000 = 6{,}200$ cub. ft. to give the same weight of air. This shows an increase in the volume from 0 to 100 deg. F. of 22.0 per cent. in order to maintain a constant weight of air.

Referring again to Fig. 7, the input for 7,000 cub. ft. for the 60 deg. F. condition is 48 kw. For 6,200 cub. yds. at 0 deg. F. the input is also 48 kw., and also at 7,550 cub. ft. at 100 deg. F. the input is 48 kw. This shows conclusively that holding a constant kw. on a machine having characteristics of this nature, a constant weight of air will be delivered irrespective of changes in temperature, barometer or altitude, or resistance through the cupola.

Results of Tests.

As a proof of the fact that this equipment will hold a constant weight of air for varying conditions, tests have been made with recording instruments, and practical results through sixteen months' operation, however, have unquestionably proved the worth of this equipment.

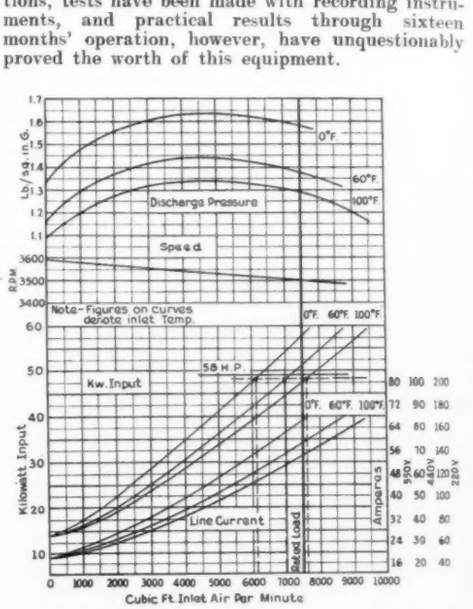


FIG. 7.—CHARACTERISTIC CURVES OF CENTRIFUGAL COMPRESSOR RATED AT 7,500 CUB. FT. PER MIN., 1.25 LBS. PER SQ. IN. BASED ON AIR AT 14.7 LBS. PER SQ. IN. ABSOLUTE, MOTOR 3-PHASE, 60 CYCLES, 220/440/550 VOLTS.

The upper curve in Fig. 7 shows the iron temperature taken with an optical-pyrometer. The consistently high temperature of the iron days should be noted. This is, of course, the result desired, and once the proper combination and distribution of pounds of coke, iron and air is determined, it can be maintained for any time, and consistent results will be obtained. The temperature curve in Fig. 7 shows a drop in atmospheric temperature around 3:30, and it should be noted at this time the inlet-air volume curve started to fall, but the pounds of air curve did not change.

There is nothing to wear out on the blower,

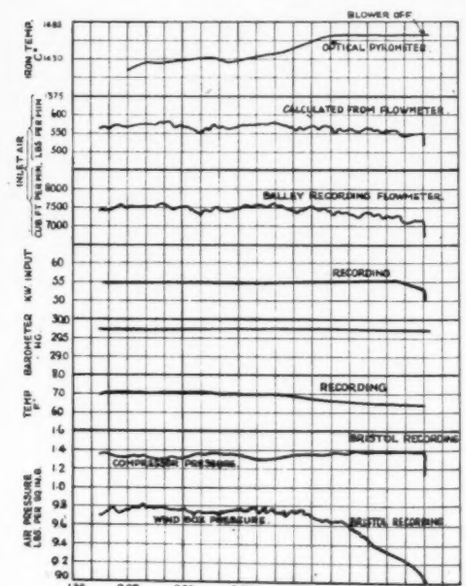


FIG. 8.—TESTS ON CENTRIFUGAL CUPOLA-BLOWER WITH AUTOMATIC CONTROL HOLDING CONSTANT WEIGHT OF AIR DELIVERED TO CUPOLA.

motor-driven blast-gate, or control, so that the weight of air will be maintained at all times and within close limit, and this factor, which has been so hard to determine and control in the past, is now automatically controlled, and attention can be concentrated on maintaining the proper relationship of the coke and iron.

When a change is made in the lining-diameter of the cupola, the weight of air can be changed to suit the new operating conditions, and, likewise, if a different kind of coke having more or less fixed-carbon is used, the weight of air can easily be calculated, and the equipment reset to give this amount, and the best operating conditions again secured. During any certain run, if it is felt that more or less pounds of air is required immediately,

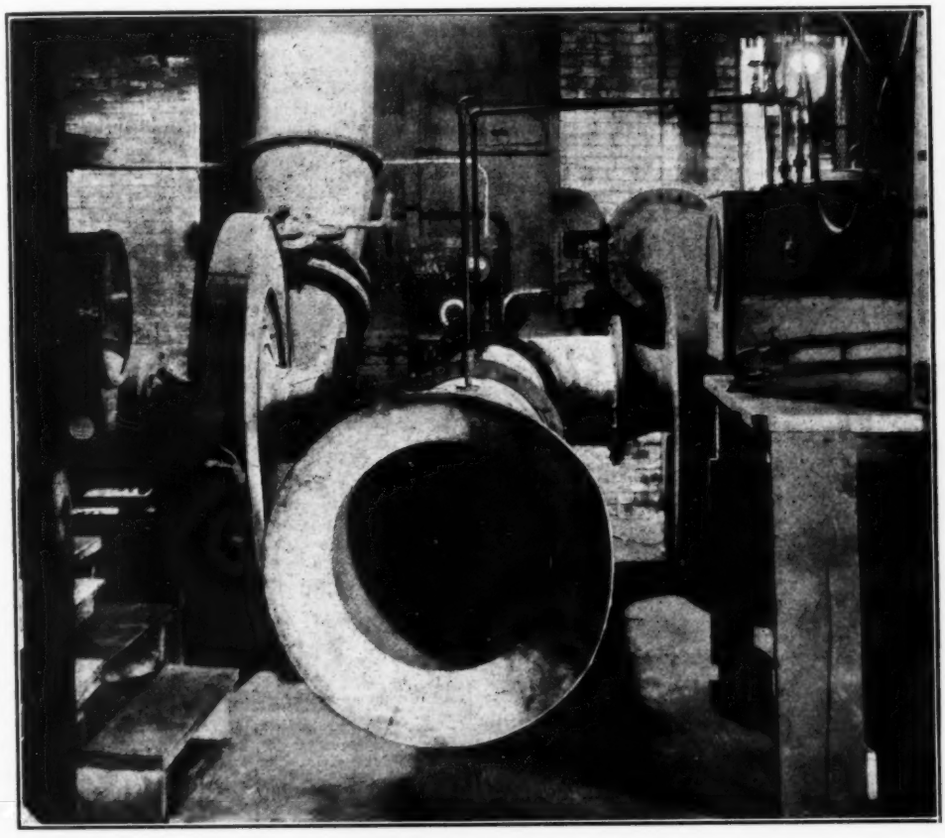


FIG. 9.—INSTALLATION OF COMPLETE EQUIPMENT WITH SPECIAL TESTING APPARATUS.

the equipment can be set in a few seconds to increase or decrease the weight of air as required.

The equipment furnished at present is shown in Fig. 4, but additional features can be added, such as an enclosing-case, with a lock, to prevent anyone but an authorised person interfering with the control; an auxiliary meter near the cupola, indicating readily the weight of air being used; and a recording meter, attached to the panel or at the cupola, to give daily records of weights of air. A two-pen recording pressure-gauge can be furnished, showing the pressure at the compressor and in the wind-box. This provides curves similar to those shown in Fig. 7, and indicates the difference in pressure on the sides of the gate. If the curves are very close, this shows that the tuyères should be broken out with a bar to reduce the pressure required on the wind-box side. In all cases the parts used are simple and of standard construction, and will give indefinite service.

Cutting Capabilities of Lathe Tools.—The Manchester Association of Engineers (St. John Street Chambers, Deansgate, Manchester) have published a brief summary of the results of an investigation made by the Lathe Tools Research Committee of the Association to determine the cutting capabilities of high-speed tools of the type commonly used on lathes for roughing cuts. Copies (5s. each) of the Summary may be obtained from the Association or the Stationery Office.

The Rise in Copper.

BY "ONLOOKER."

If other markets made a quiet ending to last year copper proved to be an exception, and gave such a display of strength on the London market as has not been seen for many a long day. Of especial interest was this localisation of the upward movement, for although the cent price appreciated and Exporters Incorporated made two advances between Christmas and December 31, which added in all £2 5s. to their quotation and brought it up to £77 7s. 6d. c.i.f. United Kingdom ports, the standard copper price moved twice as fast, and the differential narrowed to about £3. Not since 1923 has anything approaching this movement been seen.

On many occasions during the past year attention has been directed to the dangers attendant upon the very low stocks of rough copper available in this country, and it was generally agreed that sooner or later a narrowing of the margin between electro and standard prices was inevitable. How long the alteration in the relationship of the two qualities would have been deferred it is hard to say, but as very often happens in such cases, something occurred to change the situation which had no relation to supply and demand. This was an earthquake in Chile, which at the onset was not thought much about, but eventually through the realisation that production would probably be curtailed caused such a rush to secure supplies of English rough copper that panic conditions prevailed for a few days.

Once again the copper market has shown its power to change with lightning rapidity, for before Christmas it looked very much as if the top of the rise had been reached, and with business very quiet and the serious condition of the King imparting a gloomy tendency to the outlook, quite a big bear account came into being. The extraordinary developments which followed so rapidly on this dull market compelled bears to rush to cover, and since rough copper was all but unobtainable many short positions were liquidated in best select. On the second day of the New Year cash standard was quoted at the close of the midday session at only £2 below the price of wire bars, which had advanced 5s. on the quotation of December 31, January 1 being a *dies non* as far as markets were concerned both in London and New York.

At the time of writing talk is all in favour of higher prices all round, and it is freely predicted that 17 cents will be reached in the United States, which will mean electro over £80 here. Scrap values have moved up in no uncertain fashion, and there is much talk of a shortage, but this is probably due more to the fact that holders are "sitting on" parcels in the hope of still higher prices later on. The excitement must obviously die down, and since the rise has been brought about more by an artificial squeeze than by genuine trade demand, the reaction that follows may well be sharp. Production will be stimulated beyond the strength of the Exporters Incorporated to control it, and already there is talk of shipments of rough copper from Germany to this country. Abnormal situations bring their own cure, and the recent flurry in copper prices may well prove to be the final struggle against the evil of depleted stocks in English warehouses.

Famine conditions do *not* truly exist in the copper situation, and it is very dangerous to take anything but the broad view in sizing up the situation. Not many months ago it was reported that Bessemer brands for Europe would be almost unobtainable in 1929 owing to the absence of Congo shipments, but latterly offers in plenty of American blister copper for delivery this year have been received by consumers in this country. In London there has been something like a dog-fight over the 5,000 tons or so of rough copper available in English warehouses, while in America there is enough and to spare for all comers.

Although the rise in copper has on this occasion emanated from London, and has been due very much to skilful manipulation of the possibilities latent in the situation, consumers in America, who evidently still set a good deal of store by market movements on this side, have rushed in a body to secure cover and have naturally precipitated a rise in the cent price. Buyers in Britain have also purchased fairly freely, but the daily quotas of the exporters' agents have not been large, and as far as we are concerned there certainly will not be any need for the exporters to issue another warning about buying in excess of requirements! In due course it will be interesting to know to what cause the copper combine assigns the New Year rise in their product!

Steel Tube Manufacture.

At a meeting of the West of Scotland Iron and Steel Institute in Glasgow on January 25, Mr. James Mitchell, of Messrs. Stewarts & Lloyds, read a Paper on the "Manufacture of Iron and Steel Tubes." Mr. Mitchell stated that in the process of manufacture both wrought iron and steel were used; although the quantity of iron now worked up was comparatively small, it was relatively expensive, and was being replaced by mild steel. There were, however, certain classes of work for which engineers preferred wrought iron, more particularly in gas and steam services, and for this they would continue to use it in spite of the greater cost. The bulk of the ferrous tubes now made and sold were of steel, and with the development of weldless-tube manufacture the quantity and variety of steel used was expanding rapidly. There was available to users an extensive series of products. With properly-equipped and modern plants it should be possible to produce tubes of any desired properties in any of the standard commercial alloys by methods best suited to the conditions to be met with in service.

Continental Steel Trust.—It is reported that representatives of British and Polish steelworks will be invited to the quarterly meeting of the Continental Steel Trust, to be held in Brussels on March 14, when it is proposed to discuss the question of the prolongation of the Trust.

The Development of High Duty Cast Iron.

(*Continued from page* 84.)

till they get right down into the melting-zone. Corsalli prefers a cupola having one or more side-shafts into which the fuel is charged; the remainder of the material goes into the main shaft into which the others converge at the bottom, where the tuyeres are located. It is stated that the air-blast may be pre-heated and that it is necessary to moisten the coke to prevent premature combustion. He claims to adjust the carbon-content of the tapped-metal by varying the volume of blast and the amount of free-oxygen introduced, and that his iron has a running temperature of 1,480 deg. C. and under 3 per cent. of carbon.

While the above developments are interesting and serve to indicate tendencies in cupola practice, it is, of course, a fact that many British foundrymen, by means of close metallurgical control and well-designed but perfectly normal plants, are able to turn out a product containing very little more than 3 per cent. of carbon, while in the open-hearth type of furnace almost any analysis may be produced, though not as yet on a satisfactory cost-basis for general castings.

Super-heating Experiments.

The question of super-heat is an interesting one. Dr. Piwowarsky has pointed out how super-heating a molten iron retards graphitisation on subsequent cooling and refines the graphite due to complete solution of graphite-particles in the molten metal and the driving-off of dissolved gases. He also appears to conceive that carbon is held in solution in molten metal in two different forms, probably as elementary-carbon and as carbide of iron respectively; that high super-heating favours the latter condition and that this favours small, well-dispersed and rounded particles on subsequent cooling and graphitisation.

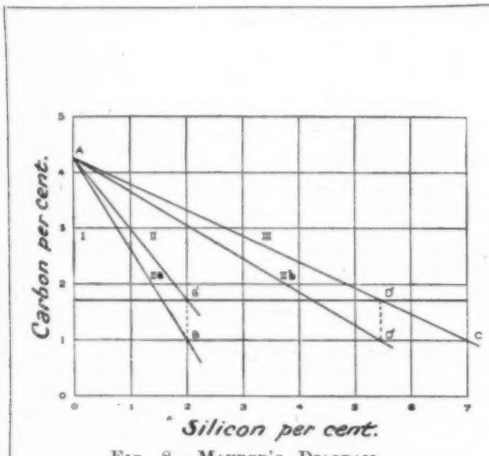


FIG. 8.—MAURER'S DIAGRAM.

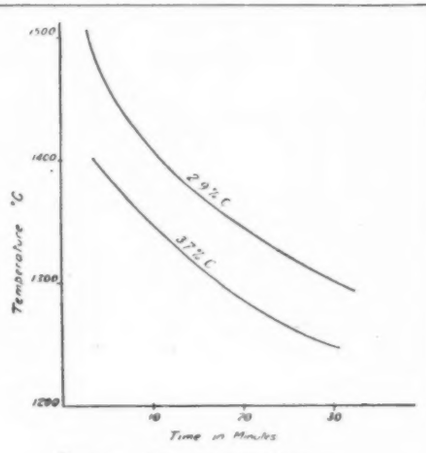


FIG. 9.—HANEMANN'S DIAGRAM.

Dr. Hanemann has also studied this question of super-heating, and Fig. 9 shows a diagram prepared by him which he claims demonstrates the variations of time and temperature of super-heating which will produce complete graphite-solution for two particular compositions. This diagram makes no allowance for variations in silicon, phosphorus, etc., and will probably need modification if it is to be of practical use in the foundry. It is possible that the process of jolting the molten iron on a special jolting-table, as outlined by Irresberger, which in at any rate some circumstances is known to have a beneficial effect on graphite-refinement, may owe its effect to this same action of getting rid of small particles of undissolved graphite floating in the molten metal, also of slag, gas bubbles, etc. The question of cooling-rate is not entered into in the developments described above, except incidentally in so much as that low-carbon irons are probably less sensitive to its influence than normal metals, but in the "Perlit" process this factor assumes a primary importance. Briefly, this process consists in the casting of a metal so low in carbon and in silicon, particularly the latter, that it would normally cool white or mottled, into moulds pre-heated so as to give retarded cooling-rate, with the result that the metal graphitises to an extent which leaves the matrix of eutectoid composition. In the carrying out of the process apparently a convenient analysis is chosen and the mould-temperature varied to suit the average section of the casting in accordance with the graphs given in the Patent Specification. Thus with total carbon 3 per cent. and silicon 1 per cent., the mould-temperatures are, for 0.4-in. section 200 deg. C., for 0.8-in. section 150 deg. C., and for 1.2-in. section 100 deg. C.

Low T. C. Iron.

It is claimed that due to the lowness of the carbon and to the casting conditions the graphite assumes a finely nodular form, but the chief point of interest about the process is that it represents a definite attempt to equalise conditions at different points across any given section. The novelty and, indeed, the efficiency of the process have been widely questioned, but many metallurgists welcome it if only for the interest it has focussed on this branch of metallurgy.

Enough has been said to show how the metallurgist approaches the problem of cast-iron structure and how his attitude has taken the form of practical developments. Another and most interesting development in the study of cast iron has been greatly stressed in several recent Papers; those of Osann* and Mitinski† have been published in THE FOUNDRY TRADE JOURNAL, and can be studied by anyone who is interested.

Every foundryman has at one time or another had painful experience of the bugbear of segregation, resulting in unevenness. It is, of course, unavoidable with normal practice that graphite should be more coarse where cooling is slower, but undoubtedly this phenomenon is more marked sometimes than it is at others in the same type of casting. The latest tendency in metallurgical thought is to call for a cast iron whose carbon, silicon and phosphorus contents are such that it is of eutectic composition. In the presence of normal amounts of the two latter elements the eutectic proportion may drop from 4.3 per cent. of carbon to somewhere between 3¼ and 3½ per cent. If a foundry iron contains over the eutectic proportion of carbon it will just after cooling contain relatively large grains of cementite, as previously seen. These on cooling will graphitise to form large and coarse flakes of primary-graphite. On the other hand, should the metal be of less than eutectic composition, then there will be large areas in the structure of free austenite, as shown in Fig. 1; these will tend at a later stage of cooling to give relatively large and closely packed patches of secondary-graphite. In either case there will be large and unevenly distributed graphite-flakes. If, however, the iron is of the eutectic composition, then the austenite and cementite are finely mingled up throughout and the subsequent graphitisation of either of them will give rise to small and well-distributed particles.

A further point is that in a material of exactly eutectic composition there is no excess constituent to set out first from the molten state, and consequently much less tendency for impurities to collect in that part of the casting which sets last. In fact, a eutectic iron is a very much more fine-grained one than a non-eutectic iron, and this fact probably explains some of those occasional splendid castings whose unusual excellence foundrymen puzzle over so greatly and which they have so much difficulty in reproducing "next time." Finally, if the research people can explain more fully about the best analyses to work to under different conditions, this development should prove a very valuable one to the practical foundryman.

Alloy Irons.

At the present time much interest is being taken in alloy-irons, particularly those containing nickel and nickel-plus-chromium. Nickel has three main effects on cast iron: (1) It promotes graphitisation silicon, but with the difference that it causes the graphite to assume a finely nodular form; (2) it toughens and hardens the pearlite and refines its crystalline structure, and (3) it makes the metal less sensitive to cooling-rate, thus giving greater uniformity of structure across sections and between thick and thin sections.

One of the most valuable effects of nickel is that when used in the correct proportions and when it has pearlite in the structure to act upon, while it improves machinability by eliminating hard carbide-spots, it raises both the toughness and the over-all hardness of the metal by its effect on the pearlite. Thus it has been found that whereas normal irons give trouble in the machine shop when the hardness goes above 200 Brinell, nickel-irons can readily be machined when showing a Brinell hardness of 250 and giving a correspondingly increased resistance to wear. Nickel cannot be added blindly and will not make a bad iron good; it can only exert its influence when it has combined carbon in the form of pearlite to work on.

Chromium has also three chief influences on cast iron: (1) Unlike nickel, it retards graphitisation, tending to form free-graphite; (2) like nickel, it toughens, hardens and refines the pearlite; and (3) like nickel, it reduces the influence of cooling-rate. Thus, when it is desired to counteract the graphitising influence of nickel while using its other valuable properties, the two may be used together. This is done generally in the proportions of between 3 and 2 of nickel to 1 of chromium, and tough, hard-wearing and yet machinable cast iron may be produced by this means.

The foregoing remarks should help the industry, particularly the practical foundryman, to understand the aims and objects of the metallurgist, and the lines along which he is endeavouring to work, in order that they may co-operate with him in appreciation and sympathy for the common good.

* Vol. 39, p. 448.
† Vol. 39, p. 413.

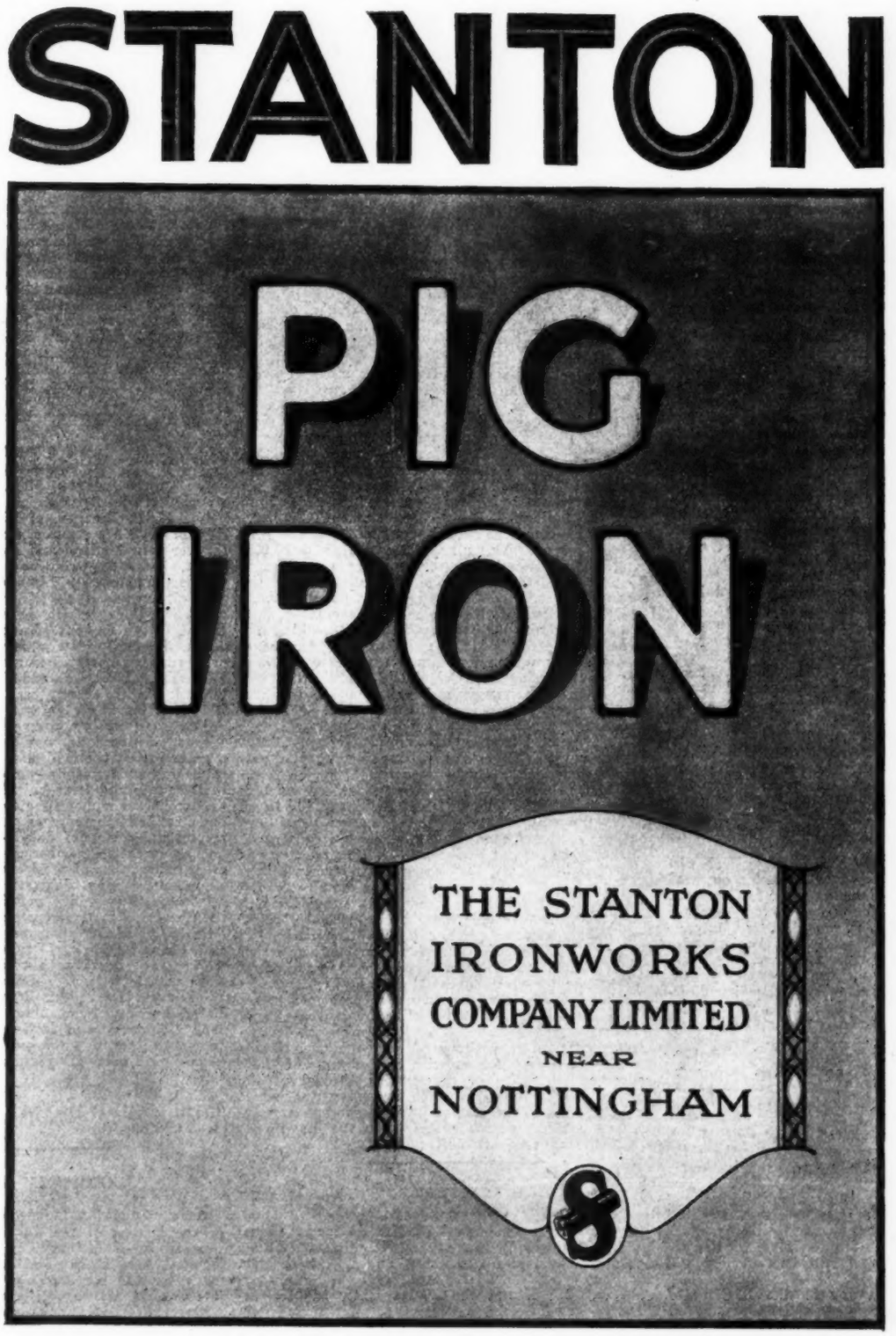
A New Foundry Bulletin.

The Belgian Foundry Employers' Federation and the Belgian Foundrymen's Technical Association have jointly published an official bulletin. It is to appear monthly, and the first issue (January) contains the story of the birth of the Employers' Federation and the re-constitution of the Technical Association under the presidency of Mr. Marcel Remy. In addition there is a Paper on foundry sands by Mr. Masson, of the Fonderies de Chênée.

Communications relative to this publication should be addressed to Mr. A. Stiévenard, 11, rue du Congrès, Brussels, Belgium.

Wages in the Scottish Pig-Iron Trade.

Messrs. Kerr, MacLeod and Macfarlan, C.A., Glasgow, have intimated to the joint secretaries of the Board of Conciliation for the Regulation of Wages in the Pig-iron Trade of Scotland that, having examined the employers' books for three months ending December 31, 1928, they certify that the net selling price is £3 11s. 9d. This means that wages of the workmen will be unaltered.


STANTON
PIG
IRON
THE STANTON
IRONWORKS
COMPANY LIMITED
NEAR
NOTTINGHAM

Trade Talk.

EMPLOYEES OF THE Dalmellington Iron Company, Limited, Works Department, Coylton and Burnfoothill, have contributed to charities £85.

THE FURNESS SHIPBUILDING COMPANY, LIMITED, Haverton Hill-on-Tees, have secured orders for three 10,000-ton steamers for Cardiff owners.

MESSRS. LOBNITZ & COMPANY, LIMITED, Renfrew, have received an order from the London & North-Eastern Railway for a bucket dredger for use at the Hull docks.

MESSRS. ALEX. STEPHEN & SONS, LIMITED, have launched from their yard at Linthouse a cargo steamer of 6,300 tons gross, which was named the "Jumna," for Messrs. James Nourse, Limited, London.

MESSRS. SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have transferred their boilerworks at Elswick to Scotswood, the operation being carried out with the loss of only two days' work.

IN THE WORKS OF Messrs. John G. Kincaid & Company, Limited, shipbuilders and engineers, Greenock, a fire broke out. The general engineering store was the only part involved, and not much damage was done.

IT IS UNDERSTOOD that the Cabinet have decided to refer to a committee of Ministers for further examination the request of the Iron and Steel Trades Confederation for an inquiry into the condition of the iron and steel industry.

WATSONS (METALLURGISTS), LIMITED, Sheffield, have completed the largest Greaves-Etchells electric steel furnace ever made. It has a capacity of 30 tons, and is being supplied to a steelworks in Spain, where it will replace an open-hearth furnace.

IT IS STATED in well-informed circles that the share of the new naval construction about to be placed by the Admiralty which will go to the Clyde will be small. It is expected that only two of the eight destroyers will be built on Clydeside.

THE MANAGEMENT of the Royal Dutch Blast Furnace and Steel Works intend to erect a third blast furnace this year and a third coke-oven battery. The surplus gas from the coke ovens is to be disposed of by the undertaking for long-distance distribution.

THE DIRECTORS of Messrs. Ward & Goldstone, Limited, of Manchester, insulated cable makers, recommend that £8,000 of the unappropriated profits be capitalised, and that four ordinary shares of 5s. each be added to every ten £1 preference shares now held.

THE MANITOBA ROLLING MILLS, LIMITED, of Winnipeg, are planning the erection of a modern steel-rolling mill at Calgary, on which an initial expenditure of $400,000 is to be made, with provision for the employment of 160 men. A twelve-acre factory site in eastern Calgary has been sold to the company by the city.

EXCITEMENT WAS CAUSED in the Kinning Park district of Glasgow recently, when an explosion occurred in the works of Messrs. John Jackson & Company, Limited, Craig Street. Hugh Smith was acetylene welding some steel drums when one of them burst, the end blowing out and striking him on the legs. He died soon after being removed to the Victoria Infirmary.

MR. S. C. GOODWIN, chairman and managing director of the Neepsend Steel & Tool Corporation, Limited, Sheffield, has concluded on behalf of his firm a contract for the purchase of Messrs. Jonas & Colver, Limited, steel makers, Sheffield. It is intended to continue the manufacture of special steels and maintain the business of Jonas & Colver as a separate company. For this purpose a new company in the old name will be formed.

MEMBERS OF THE Amalgamated Society of Woodcutting Machinists in Grangemouth struck the right note the other night in their smoker programme. Underneath a realistic drawing of a circular saw appeared the kind thought, "Let luntin' pipe and sneeshin' mull be handed roun' wi' richt guid wull." A very pleasant evening was enjoyed with members from Bo'ness and Falkirk. To see some of the old fellows do the eightsome reel was a heartening and spirited sight.

AS A RESULT OF the granting by the Ministry of Transport of an order for a new light railway at the east end of Jarrow a considerable area of land will be opened out for industrial purposes. The new railway, which was applied for by the Mercantile Dry Docks Company, Limited, will serve to open out the East End Estate, which is being developed by the company, and should also prove of value in the event of the scheme for the development of Jarrow Slake being put into operation.

IN A CIRCULAR to the shareholders of Murex, Limited, tungsten manufacturers and ironfounders, it is stated that the goodwill, patents and trade marks of Thermit, Limited (the entire issued share capital of which is owned by Imperial Chemical Industries, Limited), together with certain plant and stocks, have been acquired, payment for which will be satisfied by an issue of fully-paid shares of Murex, Limited. Manufacture will be concentrated at the Murex works at Rainham, and the stocks and plant which have been acquired are being transferred there.

MESSRS. HARLAND & WOLFF, LIMITED, launched from their Govan Shipyard on January 24 a 14,150-ton motor vessel, the "Highland Hope," which they have built for Messrs. H. & W. Nelson, Limited. The vessel is intended for the carriage of chilled meat and other refrigerated cargo between South America and Britain. She is 520 ft. in length and 69 ft. in breadth, and will be fitted at Belfast with two eight-cylinder double-acting four-cycle engines of the Harland-Burmeister and Wain type. At the launching ceremony Mr. Dunlop, the manager of the yard, said that they had six out of their seven berths occupied, and that they had sufficient work in hand to keep the shipyard fully occupied until the end of the year.

IT IS ANNOUNCED by the headquarters of the American Steel Foundries, at Chicago, that a large steel foundry, covering 120 acres, will shortly be erected by them at Eddystone, near Philadelphia, on the Delaware River. The capital will amount to about £4,000,000 and the company is to be styled the General Steel Castings Corporation. Mr. R. P. Lamont, president of the Chicago company, states that the new company will be organised by the Chicago company, the Baldwin Locomotive Works and the American Locomotive Company, and it will operate the Eddystone plant for the manufacture of steel castings, probably using the open-hearth process. Officials of the new company have not yet been announced.

AN IMPORTANT order for transformers has been placed by the Central Electricity Board with Ferranti, Limited, of Bush House, London, W.C. The contract is for 60,000-k.v.a., 30,000-k.v.a., and 20,000-k.v.a., 132-kilovolt, three-phase units of a total capacity of 1,100,000 k.v.a. The transformers are the largest so far ordered for use in this country. Working in co-operation with the railway companies concerned, the designers have succeeded in making the largest of the 60,000-k.v.a. units suitable for transport in oil by rail under normal working conditions. The manufacturing facilities at their Hollinwood and Stalybridge factories are such as to enable the firm to build these transformers with on-load tap-changing mechanism.

THE NATIONAL FEDERATION OF IRON AND STEEL MANUFACTURERS, in a statement regarding the proposed commercial treaty between the Union of South Africa and Germany, emphasises the anxiety which is felt in industrial circles in Great Britain at the terms of the proposed treaty. The Federation points out that the proposed concession to a foreign country of equality with Great Britain in tariff preference is calculated to destroy that economic solidarity in the development of the resources of the Empire to the mutual advantage of its constituent peoples which potentially should enable the Empire to be the largest and most prosperous economic unit the world has ever seen. A policy of individualism on the part of the constituent countries in developing their industrial and economic interest appears to the Federation to be calculated to destroy the enormous economic power which co-operation, dictated alike by sentiment and interest, would secure. The Federation, the statement continues, is desirous of developing, as far as practicable and consonant with the interests of those concerned, a policy of co-operation throughout the Empire in the industry which it represents, and is ready to lend the weight of its influence and support to a policy that has for its object the Empire as a self-sufficing economic unit.

Obituary.

THE DEATH IS announced of Mr. Alexander James Ritchie, who was for many years with Messrs. William Jacks & Company, Limited, iron and steel merchants, Glasgow.

MR. J. W. KYLE, who died recently at Middlesbrough, was formerly in business as an iron and steel merchant, and was a member of the Middlesbrough Exchange for over 50 years.

MR. JAMES CASSELS, founder of the firm of Messrs. James Cassels & Sons, blacksmiths, etc., Christie Lane, Paisley, died at his residence in Paisley on January 23. He was a native of Kilmarnock and was in his seventy-eighth year.

IT IS WITH deep regret that Messrs. Sternol, Limited, announce the death of their chairman, the Rt. Hon. Lord Athlumney, who had occupied the position since the close of the war. Lord Athlumney was extremely popular with the great staff of this well-known and old-established oil company.

Contracts Open.

Aberdovey, February 9.—6,786 yds. of 4-in. diam. steel pipes, for the Towyn District Council. The Office of the Surveyor, Towyn.

Brussels, February 11.—16 electrical cranes, for the Ghent Municipality. The Department of Overseas Trade. (Reference A.X. 7398.)

Cairo.—Five 40-ft. skeleton wrought-iron lattice posts, with cast-iron bases, for the Egyptian State Railways. The Chief Inspecting Engineer, 41, Tothill Street, London, S.W. (Reference E.S.R. 8066.)

Dundee, February 4.—Cast-iron pipes, for the Corporation (Water Department). Mr. G. Baxter, junr., engineer and manager, 93, Commercial Street, Dundee.

Johannesburg, February 15.—Mild-steel channels, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 7416.)

Johannesburg, March 7.—Locomotive boilers, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference A.X. 7417.)

Manchester, February 4.—Ventilating grids and other castings, for the Public Health Committee. Mr. J. Irvine, Public Health Department, Phœnix Buildings, 20, Cooper Street, Manchester.

Teddington, February 5.—Cast-iron gas and water mains, for the Commissioners of H.M. Works, etc. The Contracts Branch, H.M. Office of Works, King Charles Street, London, S.W.1. (Fee £1 1s., returnable.)

Personal.

SIR PHILIP DAWSON, M.P., has accepted the chairmanship of the Duffield Iron Corporation, Limited.

MR. G. P. PILLING, of Pilling & Company, Philadelphia, U.S.A., pig-iron manufacturers, is spending six weeks in England and Holland on a business trip.

MR. DUXBURY, who was formerly with Messrs. Crofts (Engineers), Limited, has been appointed works manager of the Keighley Gear Cutting Company, Keighley, which is associated with Messrs. David Brown & Sons (Huddersfield), Limited.

MR. JAMES JORDAN, a foundry executive and engineer, who has operated many foundries, and specialises in machine tools, oil and Diesel engines, and shipbuilding, will shortly sail from America for a European tour.

THE DIAMOND WEDDING of Mr. and Mrs. Henry Woods, of Greenock, was celebrated on 23rd inst. at a gathering in the Oddfellows' Hall, when the couple were presented with a wallet of Treasury notes by their family and friends. Mr. and Mrs. Woods came to Greenock six months after they were married and have resided there ever since. Mr. Woods was employed by Messrs. Caird & Company for 49 years, and as an active member of the A.E.U. filled, among other offices, that of president of the Greenock branch.

MR. AND MRS. WILLIAM WALKER, of Falkirk, celebrated their golden wedding on January 17, having been married in Grahamston Parish Church on that date 1879. Mr. Walker began work with his father as a Berlin-blacker and brass finisher in Falkirk Ironworks, and served with that firm for 24 years. He then transferred to McDowell, Steven & Company, Limited, at Laurieston Foundry as a pattern fitter. Later he served at Abbot's Foundry, Grahamston Iron Company, and latterly at Burnbank Foundry, where he is still employed and continues to take a keen interest in all pertaining to the ironfounding industry.

Will.

MESSHAM, A., of Deepdale Road, Preston, brassfounder £16,906

Company Meeting.

Cammell Laird & Company, Limited.—At a meeting of the holders of the 4½ per cent. mortgage debenture stock of Messrs. Cammell Laird & Company, Limited, held at Sheffield last week, the agreements made for the concentration of the commercial steel interests of Messrs. Vickers, Limited, Vickers-Armstrongs, Limited, and Cammell Laird & Company, Limited, and of the railway carriage and wagon manufacturing interests of Vickers and of Cammell Laird, were confirmed. MR. W. L. HICHENS, who presided, said that the fusion would create a 'powerful railway carriage and wagon group, which would be the largest of its kind in this country, and probably in the world. It was felt that the policy of amalgamation put forward was one which was calculated to promote the interests of the steel industry generally. The agreements have already been ratified by the general shareholders of Cammell Laird & Company, Limited, and by the 5 per cent. first mortgage and mortgage debenture stockholders.

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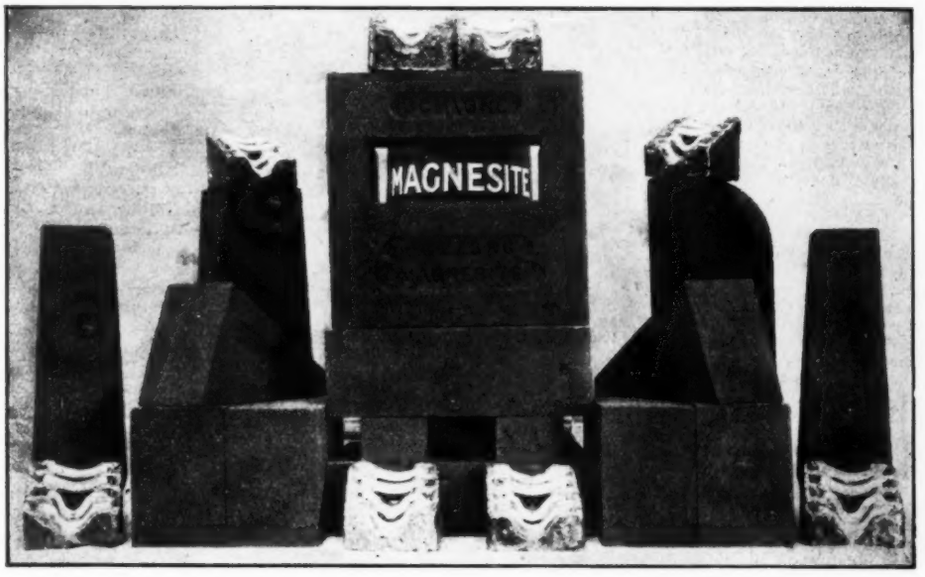

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The temperature is controlled by Holdcroft's Thermoscope Bars, sets of which are placed in each kiln. The even bending of the bars shown above, and which are taken from several kilns, illustrates the regularity of firing.

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The position in the Cleveland iron trade remains much the same as last reported. makers in this area devoting the bulk of furnace outputs to supplying the needs of the local steel producers, now experiencing increasingly heavy demands for this class of material, both on home and export account. Unfortunately, at the moment the outlook for foundry pig continues unsatisfactory, as contrasted with the activity in the hematite section, and unless some change for the better should develop in the demand for cast material, both light and heavy, in the near future, an early improvement in these conditions can hardly be anticipated with any degree of confidence. For the immediate present, however, the Cleveland ironmasters are in a very enviable position, surplus stocks having been almost entirely exhausted, and thus they can regard with indifference the undercutting by Midland ironmasters, who continue to secure a substantial share of the Scottish trade. However, there is no hint of any price concessions in Cleveland, and quotations to home and foreign buyers are all unchanged, as follow:—No. 1 foundry iron, 68s. 6d.; No. 3 G.M.B., 66s.; No. 4 foundry iron, 65s.; No. 4 forge iron, 64s. 6d. per ton.

The market for East Coast hematite, as outlined above, is now the more active branch of Tees-side industry conditions, which appear likely to continue on an expanding scale, while the outlook for export trade has distinctly improved of late. Hence the hematite makers have been able to clear their stocks, sell current output, and book a fair number of forward orders, with the result that they are now in a position to adhere more firmly to a quotation of 71s. per ton for mixed numbers and 71s. 6d. for No. 1 quality. On the North-West Coast, with smelters bidding against each other and East Coast competition to face, prices are barely firm, but Bessemer mixed numbers are still quoted at 71s. per ton at works.

LANCASHIRE.—A significant indication of the growing strength of the local markets for foundry pig is provided in the recent announcement of an advance of 2s. 6d. per ton by a prominent Staffordshire firm in its rates for delivery Manchester or equal distance. Quotations are also firm in all directions, with Derbyshire brands at 68s., Cleveland at 79s. and Scottish at 87s. 6d. to 90s., according to quantity and brand, all delivered locally.

THE MIDLANDS.—Movements in the markets for foundry pig in the Black Country area are still restricted by the uncertainty prevailing as to future developments, but, on the whole, the tone is distinctly steady and firmer. Current quotations are as follow: Derbyshire No. 3, 60s.; Northants. No. 3, 55s. to 56s.; North Staffordshire, 62s. 6d., all f.o.t.

SCOTLAND.—Little progress towards more active conditions in the Scotch iron trade can as yet be observed, and the labour troubles with a section of the light-castings moulders and the malleable workers, of course, tend to retard any improvement. Prices are unchanged on the basis of 70s. for No. 3 Scotch foundry iron, f.o.t. furnaces.

Finished Iron.

At Birmingham this week the slightly improved demand for crown iron is maintained, although the position generally is very irregular and bulk business is difficult to procure. None of the works engaged on crown or bolt iron is able to get sufficient support to keep the mills fully occupied, and it is only in connection with marked bars that the position is anything like satisfactory. Orders for these are coming through at a fairly good rate, but the price is unchanged at £12 at makers' works. Crown iron continues to vary in price to a considerable degree, from £9 to £9 5s. being quoted, and local makers are experiencing keen competition from outside districts.

Scrap.

Current demand for most descriptions of cast-iron material for foundry consumption is still in disappointing volume, but in Scotland some slight improvement is marked, with prices a shade firmer. Machinary quality is now quoted at 66s. 6d. to 67s. 6d., and clean heavy cast iron, suitable for foundries, at 62s. 6d. Old cast-iron railway chairs are at 66s., and light cast-iron scrap at 57s. 6d. to 58s. 6d. per ton. The above prices are all per ton, delivered f.o.t. consumers' works. At Middlesbrough there is only a moderate demand for heavy cast iron, but works are willing to pay 61s. for ordinary quality and 65s. for machinery quality. In the Midlands cast-iron scrap is in rather better demand; 65s. delivered is offered for machinery quality, broken into cupola sizes, and 55s. delivered for light cast-iron scrap. The latter is scarce, and many of the foundries have difficulty in obtaining sufficient for their requirements.

Steel.

In semi-finished steel the British works are taking a considerable share of the orders that come on the market, although Continental material is still bought in fair quantities by users. At Sheffield there is no great activity, although a steady flow of business is developing. There are brisk sales of basic billets, but for acid qualities the demand continues very slack. Soft basic wire rods are a good market. No price changes are recorded. Local industry is beginning to make a considerably better showing. Makers of special steels are well booked, and open-hearth steel production is on a large scale. The railway companies are beginning to place business again, but so far it is well below the normal. In the tinplate market business continues steady, and makers are standing to their quotations, which range as follow: Coke tinplates in approved specifications, 18s. to 18s. 3d. basis, net cash, f.o.b. Welsh ports.

Metals.

Copper.—Business generally in the markets for base metals during the past week, although steady, has not been in such active volume as has lately been experienced, while somewhat similar conditions are reported in American advices. Notwithstanding the quietude thus indicated, there has been no weakening of warrant copper prices, while consumptive demand is still sufficient to keep pace with producing interests at present levels.

Closing quotations are :—

Cash.—Thursday, £76 6s. 3d. to £75 7s. 6d.; Friday, £76 15s. to £75 17s. 6d.; Monday, £77 1s. 3d. to £77 2s. 6d.; Tuesday, £77 2s. 6d. to £77 5s.; Wednesday, £77 6s. 3d. to £77 7s. 6d.

Three Months.—Thursday, £74 7s. 6d. to £74 8s. 9d.; Friday, £74 5s. to £74 7s. 6d.; Monday, £74 8s. 9d. to £74 10s.; Tuesday, £74 12s. 6d. to £74 13s. 9d.; Wednesday, £74 15s. to £74 16s. 3d.

Tin.—Some obscurity still prevails in the position of standard tin, due to the uncertainty entertained as to the actual volume of stocks now held in this country, which are alleged to be manipulated by outside interests, always ready to be unloaded on the market when the occasion presents a favourable opportunity. The statistical conditions, however, point towards lower price levels, but it is impossible to judge such an artificial market, as this is at the moment, from normal estimates when surplus stocks are still being strongly held.

Official closing prices :—

Cash.—Thursday, £221 17s. 6d. to £222; Friday, £222 10s. to £222 12s. 6d.; Monday, £221 10s. to £221 12s. 6d.; Tuesday, £220 5s. to £220 7s. 5d.; Wednesday, £220 2s. 6d. to £220 5s.

Three Months.—Thursday, £221 17s. 6d. to £222; Friday, £222 10s. to £222 12s. 6d.; Monday, £222 to £222 5s.; Tuesday, £221 2s. 6d. to £221 5s.; Wednesday, £221 2s. 6d. to £221 7s. 6d.

Spelter.—A rather better tone has been in evidence in the market for ordinary spelter of late, and a moderate volume of business is reported. Demand on the Continent has not been large, due to some extent to the severe weather experienced hampering trade. With regard to the curtailment of output, there seems to be an almost general belief that the Syndicate agreement is already being put into effect, which impression has provided some measure of support to the market.

Daily quotations are :—

Ordinary.—Thursday, £26 5s.; Friday, £26 3s. 9d.; Monday, £26 7s. 6d.; Tuesday, £25; Wednesday, £26 2s. 6d.

Lead.—In the market for soft foreign pig consumptive demand has been very moderate, with a limited inquiry both from consumers in England and on the Continent, and, unless prices show an upward tendency, buying will continue on its present hand-to-mouth basis.

Prices have been :—

Soft Foreign Prompt.—Thursday, £22 5s.; Friday, £22; Monday, £22 5s.; Tuesday, £22 3s. 9d.; Wednesday, £22 2s. 6d.

Newark Junior Engineering Society.

The young foundrymen and engineers of Newark recently held their first meeting of the new session arranged under the auspices of the Newark Engineering Society.

In his presidential address, Mr. W. A. Richardson said that although the society was in its first year the membership had reached 152, and the financial position showed a considerable balance.

In order to stimulate the interest of the students still more, a prize was to be offered for the best Paper submitted during the year, and a special committee had been formed, upon which each local firm was represented, for the purpose of assisting competitors with the choice of subjects and advice. The adjudicators were Mr. J. T. Graham, manager of Worthington-Simpson, Limited, Lowfield Foundry, Newark, and Mr. C. G. H. Richardson, who had recently been appointed works manager of Messrs. Ransome & Marles Bearing Company, Limited, Newark-on-Trent. The president extended his thanks to the many enthusiastic helpers and to the trade Press, and finally expressed the hope that his address would be only a forerunner of a series of distinguished presidential addresses.

Alarming Occurrence in Motherwell.

A week ago the inhabitants of Motherwell were greatly perturbed by lumps of metal hurtling through the air, as if from nowhere, to the danger of life. On Tuesday a piece of metal weighing 6 lbs. crashed on to the pavement at Motherwell Cross so narrowly missing a four-year-old child that his coat was ripped. On the following day a similar happening occurred in another part of the town, when a lump of metal weighing 28 lbs. crashed through the fitting shop roof of Messrs. Anderson & Boyes, Limited, at Flemington. Fortunately the metal struck a wall and rebounded to the middle of the floor, but it is almost a miracle that none of the workmen were injured. Examination showed that in both cases the metal was rough steel, and inquiry has definitely established that the fragments were projected from a local steel works during blasting operations. The first piece fell at a spot nearly a mile from the scene of operations and inquiry is being made into the occurrence.

Students' Corner.

Q.—What is the rôle of coal-dust in the sand mixture?

A.—Coal-dust is mixed with facing for green sand work only, for the definite purpose of inducing a clean skin on iron castings. When the molten metal comes into contact with the coal-dust mixed with the sand, a gas is generated which deposits a carbon film or thin covering on the surface of the mould walls and prevents the molten iron fusing, or burning the weak or fusible silicates in the sand mixture. This thin covering or film deposited will resist a higher temperature than that of the molten iron, assuming the correct quantity has been mixed with the sand. The addition of dry carbon-blacking to the facing sand will serve the same purpose, but not in the same manner. Coal-dust is also much cheaper than carbon-blacking, and hence more economical.

Q.—If coal-dust were not included in the facing-sand mixture what would be the result?

A.—In the absence of coal-dust the casting will appear a dirty white or grey colour, with a skin of partly-fused weak silicates in the sand; often such a skin is only removed with difficulty and can be associated with an unsightly casting.

1200 SIZES and TYPES of SIROCCO FANS

SOME "SIROCCO" CATALOGUES.

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FOUNDRY & FURNACE COKE

J. C. ABBOTT & Co Ltd
LLOYD'S BANK CHAMBERS, NEW STREET, BIRMINGHAM.
TELEPHONE: MIDLAND 170.

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	77 6 3
Three months	74 15 0
Electrolytic	79 10 0
Tough	78 0 0
Best selected	78 10 0
Sheets	104 0 0
India	88 10 0
Wire bars	79 15 0
Do. February	79 15 0
Do. March	79 15 0
Ingot bars	79 15 0
H.C. Wire rods	84 0 0
Off. av. cash, December	69 7 7 3/16
Do. 3 mths., December	69 4 4½
Do., Sttlmnt., December	69 7 7 1/16
Do., Electro, December	75 4 10 15/16
Do., B.S., December,	73 16 10½
Aver. spot price, copper, Dec.	69 7 7 5/16
Do. Wire bars, December	75 9 8 15/16
Solid drawn tubes	14½d.
Brazed tubes	14½d.
Wire	10¼d.

BRASS.

Solid drawn tubes	12½d.
Brazed tubes	14½d.
Rods, drawn	11½d.
Rods, extd. or rild.	7½d.
Sheets to 10 w.g.	10½d.
Wire	10½d.
Rolled metal	10½d
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£ s. d.
Standard cash	220 2 6
Three months	221 2 6
English	220 5 0
Bars	222 5 0
Straits	223 0 0
Australian	220 5 0
Eastern	224 0 0
Banca	221 10 0
Off. av. cash, December	227 13 11 7/16
Do., 3 mths., December	226 8 3 9/16
Do., Sttlmt., December	227 12 10 1/16
Aver. spot, December	227 13 11 7/16

SPELTER.

	£ s. d.
Ordinary	26 2 6
Remelted	24 15 0
Hard	20 0 0
Electro 99.9	28 15 0
English	26 7 6
India	21 10 0
Zinc dust (Nom.)	36 10 0
Zinc ashes	8 5 0
Off. aver., December	26 12 2 1/16
Aver., spot, December	26 12 2 1/16

LEAD.

	£ s. d.
Soft foreign ppt.	22 2 6
English	23 10 0
Off. average, December	21 10 8 1/16
Average spot, December	21 6 10 7/16

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	34 0 0
Do. V.M. ex whf.	33 5 0
Rods	44 0 0
Boiler plates	32 0 0
Battery plates	32 15 0

ANTIMONY.

	£ s. d.
Special brands, Eng.	54 10 0
Chinese	37 10 0
Crude	33 10 0

QUICKSILVER.

	£ s. d.
Quicksilver	22 5 9

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	£7 17 6
45/50%	£12 0 0
75%	£19 0 0
Ferro-vanadium—	
35/50%	14/- lb. Va.
Ferro-molybdenum—	
70/75% c. free	4/- lb. Mo.
Ferro-titanium—	
23/25% carbonless	1/- lb.
Ferro-phosphorus, 20/25%	£18 0 0
Ferro-tungsten—	
80/85%, c. fr.	1/5 lb.
Tungsten metal powder—	
98/99%	1/10 lb.
Ferro-chrome—	
2/4% car.	£30 15 0
4/6% car.	£21 15 0
6/8% car.	£20 17 6
8/10% car.	£20 10 0
Ferro-chrome—	
Max. 2% car.	£33 5 0
Max. 1% car.	£36 0 0
Max. 0.70% car.	£44 0 0
70%, carbonless	1/- lb.
Nickel—99%, cubes or pellets	£175 0 0
Ferro-cobalt	9/- lb.
Aluminium 98 99%	£95 0 0
Metallic chromium—	
96/98%	2/6 lb.
Ferro-manganese (net)—	
76/80% loose	£13 15 0
76/80% packed	£14 15 0
76/80%, export	£14 10 0
Metallic manganese—	
94/96%, carbonless	1/6 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0 2 0
Finished bars, 18% tungsten	£0 2 9

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 3/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.
Bars cut to length, 10% extra.	

SCRAP.

	£ s. d.
South Wales—	
Hvy. steel	3 10 0
Bundled steel and shrngs.	3 5 0 to 3 9 0
Mixed iron and steel	3 4 0 to 3 5 0
Heavy cast iron	2 18 0
Good machinery for foundries	2 18 0 to 3 0 0
Cleveland—	
Heavy steel	3 2 6
Steel turnings	2 8 6
Cast iron borings	2 4 0
Heavy forge	3 7 6
W.I. piling scrap	3 0 0
Cast-iron scrap	3 1 0 to 3 5 0
Lancashire—	
Cast-iron scrap	2 15 0 to 3 5 0
Hvy. wrought	3 11 6
Steel turnings	2 7 0
Scotland—	
Heavy steel	3 7 6
Cast-iron borings	2 12 6
Wrought-iron piling	3 7 6
Heavy machinery	3 7 6

London—Merchants' buying prices delivered yard.

	£ s. d.
Copper (clean)	57 0 0
Brass	39 0 0
Lead (less usual draft)	19 10 0
Tea lead	16 10 0
Zinc	17 0 0
New aluminium cuttings	67 0 0
Braziery copper	52 0 0
Gunmetal	55 0 0
Hollow pewter	150 0 0
Shaped black pewter	105 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	68/6
Foundry No. 3	66/-
Foundry No. 4	65/-
Forge No. 4	64/6
Hematite No. 1	71/6
Hematite M/Nos.	71/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	78/-
,, d/d Birm.	85/6
Midlands—	
Staffs. common*	70/-
,, No. 4 forge	57/-
,, No. 3 fdry.	62/6
Shrops. basic	—
,, Cold blast, ord.*	—
,, ,, roll iron*	—
* d/d Birmingham.	
Northants forge	52/-
,, fdry. No. 3	55/6
Derbyshire forge	59/-
,, fdry. No. 3	60/-
,, basic	65/-
Scotland—	
Foundry No. 1	75/-
,, No. 3	70/-
Hem. M/Nos.	75/-
Sheffield (d/d district)—	
Derby forge	61/6
,, fdry. No. 3	64/-
Lincs. forge	62/6
,, fdry. No. 3	65/6
E.C. hematite	80/-
W.C. hematite	83/6
Lincs. (at furnaces)—	
Forge No. 4	58/-
Foundry No. 3	61/-
Basic	60/-
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	68/-
Northants foundry No. 3	—
Dalzell, No. 3(special)	100/- to 102/6
Summerlee, No. 3	87/6 to 90/-
Glengarnock, No. 3	87/6 to 90/-
Gartsherrie, No. 3	87/6 to 90/-
Monkland, No. 3	87/6 to 90/-
Shotts, No. 3	87/6 to 90/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.	£ s. d.
Bars (cr.) nom.		10 5 0
Nut and bolt iron	8 10 0 to 8	17 6
Hoops		11 10 0
Marked bars (Staffs.) f.o.t.		12 0 0
Gas strip		11 10 0
Bolts and nuts, ½ in. × 4 in.		15 5 0
Steel—		
Ship plates	8 7 6 to 8	12 6
Boiler plts.		10 10 0
Chequer plts.		10 12 6
Angles		7 17 6
Tees		8 17 6
Joists		7 17 6
Rounds and squares, 3 in. to 5½ in.		8 17 6
Rounds under 3 in. to ½ in. (Untested)		7 15 0
	and upwards	
Flats, over 5 in. wide and up		8 7 6
Flats, 5 in. to 1½ in.		7 17 6
Rails, heavy		8 10 0
Fishplates		12 10 0
Hoops (Staffs.)		10 10 0
Black sheets, 24g.	10 0 0 to 10	10 0
Galv.cor.shts.,24g.	13 10 0 to 13	15 0
Galv. fencing wire 8g. plain		12 10 0
Billets, soft	6 5 0 to 6	12 6
Billets, hard	7 5 0 to 7	12 6
Sheet bars		6 0 0
Tin bars		6 0 0

PHOSPHOR BRONZE.

	Per lb. basis
Strip	1 3
Sheet to 10 w.g.	1 3½
Wire	1 4½
Rods	1 3½
Tubes	1 8
Castings	1 2½

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/- to 1/8½
Wire round—	
3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	21.26
No. 2 foundry, Valley	18.00
No. 2 foundry, Birm.	16.50
Basic	19.26
Bessemer	20.79
Malleable	20.01
Grey forge	19.26
Ferro-mang. 80% d/d	105.00
O.-h. rails, h'y at mill	43.00
Bess billets	33.00
O.-h. billets	33.00
O.-h. sheet bars	34.00
Wire rods	42.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.95
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.20
Sheets, black, No. 24	2.85
Sheets, galv., No. 24	3.60
Sheets, blue an'l'd, 9 and 10	2.10
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.30
Tinplates, 100 lb. box	$5.35

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	19/- to 23/-
Durham and North.	
,, foundry	16/-
,, furnace	15/3
Midlands, foundry	—
,, ,, furnace	14/-

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes	20×14 box	18/-
,,	28×20 ,,	36/-
,,	20×10 ,,	26/3
,,	18⅞×14 ,,	18/9
C.W.	20×14 ,,	15/-
,,	28×20 ,,	33/6
,,	20×10 ,,	21/3
,,	18⅞×14 ,,	15/-
Terneplates	28×20	33/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 10 0
Bars, hammered, basis	£17 10 0 to £18 10 0
Bars & nailrods, rolled, basis	£15 15 0 to £16 15 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£20 0 0 to £24 0 0
Bars & rods, dead soft, steel	£10 0 0 to £14 0 0

All per English ton, f.o.b. Gothenburg

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes.	Fittings.
Gas	67½%	50%
Water	63½%	45%
Steam	60%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Jan. 24 ..	76	6	3	inc.	5/-
,, 25 ..	76	15	0	,,	8/9
,, 28 ..	77	1	3	,,	6/3
,, 29 ..	77	2	6	,,	1/3
,, 30 ..	77	6	3	,,	3/9

Electrolytic Copper.

	£	s.	d.		
Jan. 24 ..	79	10	0	No change	
,, 25 ..	79	10	0	,,	,,
,, 28 ..	79	10	0	,,	,,
,, 29 ..	79	10	0	,,	,,
,, 30 ..	79	10	0	,,	,,

Standard Tin (cash).

	£	s.	d.		
Jan. 24 ..	221	17	6	dec.	22/6
,, 25 ..	222	10	0	inc.	12/6
,, 28 ..	221	10	0	dec.	20/-
,, 29 ..	220	5	0	,,	25/-
,, 30 ..	220	2	6	,,	2/6

Tin (English ingots).

	£	s.	d.		
Jan. 24 ..	222	0	6	dec.	15/-
,, 25 ..	222	10	0	inc.	10/-
,, 28 ..	221	10	0	dec.	20/-
,, 29 ..	220	5	0	,,	25/-
,, 30 ..	220	5	0	No change	

Zinc Sheets (English).

	£	s.	d.		
Jan. 24 ..	34	0	0	No change	
,, 25 ..	34	0	0	,,	,,
,, 28 ..	34	0	0	,,	,,
,, 29 ..	34	0	0	,,	,,
,, 30 ..	34	0	0	,,	,,

Spelter (ordinary).

	£	s.	d.		
Jan. 24 ..	26	5	0	inc.	10/-
,, 25 ..	26	3	9	dec.	1/3
,, 28 ..	26	7	6	inc.	3/9
,, 29 ..	26	0	0	dec.	7/6
,, 30 ..	26	2	6	inc.	2/6

Lead (English).

	£	s.	d.		
Jan. 24 ..	23	10	0	No change	
,, 25 ..	23	10	0	,,	,,
,, 28 ..	23	10	0	,,	,,
,, 29 ..	23	10	0	,,	,,
,, 30 ..	23	10	0	,,	,,

BLAST-FURNACE STATISTICS.

Furnaces in Blast at the close of each Quarter making Pig-iron Specified.

Quarter ended.	Hematite.	Forge and foundry.	Basic.	Ferro-manganese	Total in blast.
1913					
March	118 2/3	169	52	18 1/3	358
June	117	163	50	14	344
September	107	157	47	13	324
December	91	154	55	13	293
1914					
March	96	146	47	11	300
June	90	143	45	12	290
September	94	133	41	15	286
December	100	136	46	12	294
1915					
March	102	130	52 2/3	10	294
June	103	126 1/3	54 2/3	10	294
September	105	117 1/3	52 2/3	11	287
December	108	111 1/3	50 2/3	15	284
1916					
March	116	106 1/3	50 2/3	12	285
June	120	106	54	13	293
September	124	107	58	13	302
December	126	110	57	18	311
1917					
March	131	111	62	16	320
June	129	116	70	15	324
September	123	102	78	19	322
December	118	99	85	13	315
1918					
March	117	102	92	15	326
June	120	108	86	16	330
September	120	104	83	14	321
December	113	108	72	15	308
1919					
March	98	109	69	13	289
June	97	107	78	7	289
September	66	99	53	5	223
December	77	113	62	8	260
1920					
March	92	108	72	10	282
June	97	119	68	12	296
September	93	122	73	12	300
December	77	125	59	13	274

Quarter ended.	Hematite.	Forge and foundry.	Basic.	Ferro-manganese	Total in blast.
1921					
March	36	70	10	3	119
June	—	1	—	—	1
September	17	41	10	—	68
December	22	41	15	3	81
1922					
March	31	46	22	7	107
June	25	55	28	9	117
September	27	74	27	10	138
December	46	83 1/3	30 2/3	10	170
1923					
March	52	93	45	10	200
June	62	103	45	13	223
September	38	98	42	11	189
December	50	99	49	9	207
1924					
March	45	94 2/3	51 1/3	10	201
June	45	91	46	8	190
September	44	85	38	5	172
December	42	87	31	7	167
1925					
March	40	84	36	9	169
June	31	76	32	9	148
September	28	67	30	5	130
December	38	74	32	4	148
1926					
March	39	79	33	4	155
June	3	5	4	2	14
September	1	4	—	—	5
December	24	33	20	2	79
1927					
March	50	86	39	7	182
June	46	86	36	10	178
September	41	78	36	7	162
December	38	72	31	6	147
1928					
March	35	70	35	6	146
June	35	65	39	3	142
September	34	55	39	6	134
December	34	53	42	6	135

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

TECHNICAL ASSISTANT.—Well-educated Foundryman, age 23, desires progressive situation; first-class training in grey iron metallurgy, knowledge of metallography, cupola practice, etc.; six years' practical foundry experience in various branches.—Box 984, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN, disengaged, desires position; 25 years' practical and technical training all classes engineering and jobbing work, mix grey iron, semi-steel, non-ferrous metals by analysis, scientific knowledge of cupola, get maximum production, can also take charge of pattern shop.—Box 966, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY MANAGER (50) desires re-engagement; wide experience of all classes of patternmaking, plate and machine moulding, and floor moulding; up-to-date productive methods at economic cost; keen organiser and disciplinarian; highest references and recommendations.—Box 968, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ADVERTISER, who has a large experience in the light castings branch of the Foundry industry and the kindred stove-grate and kitchen range trade, is open for appointment to a position of responsibility by a firm of repute; is trained in modern methods of works organisation and works accountancy, has a sound metallurgical knowledge, and possesses a live connection amongst large buyers of the goods mentioned; is used to taking entire control.—Reply to Box 970, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

YOUNG Public School man, with excellent technical education, machine shop experience, and for last three years Foundry Manager of 6/7 tons daily hydraulic and repetition casting shop, seeks new situation with scope for ability; twelve months' experience with nichromised and alloyed cast iron; member of several Technical Institutes; could be free in one month.—Wages offered, to Box 980, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROGRESSIVE Modern Foundry in the Midlands on Automobile work has a vacancy for a really smart young man with energy, ability, tact, thoroughness of ambition as credentials; must be under 32 years.—Full particulars, with wages required, to Box 978, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, Working Chargehand to take charge of small brass foundry making castings from ½ lb. to ¼ cwt., chiefly gunmetal; good knowledge of mixings to Admiralty specifications necessary; permanency to capable man.—Applications, stating experience, age, and wages required, to be sent to Box 976, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THE FORDATH ENGINEERING COMPANY, LIMITED, Hamblet Works, West Bromwich, invite applications for the post of Head Chemist for their new Laboratory.

The work will be mainly Research in connection with the making of Cores and Moulds, but will also embrace ordinary Foundry Analytical problems.

Applications will be regarded as confidential. Salary in accordance with qualifications and experience.

SITUATIONS VACANT AND WANTED. *Continued.*

FOUNDRY MANAGER required for Engineering Works in the Midlands making castings for own requirements; only men of outstanding ability will be considered.—Applications in confidence, giving age, experience and salary required, to Box 964, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

11 ACRES WORKS SITE, SHEFFIELD.
145,000 Sq. Ft. of SHOPPING, Compact and Convenient.
SIDING CONNECTIONS
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WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers, or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

PATENTS AND TRADE MARKS.

INFORMATION HANDBOOKS, Advice, and Cons. free; King's Patent Agency, Ltd.—B T. KING, C.I.M.E. (Regd. Pat. Agent, G.B., U.S.A., and Can.), 146A, Queen Victoria Street, E.C.4. 40 years' refs. 'Phone: 0682 Central.

THE proprietor of British Patent No. 244,315, dated March 30, 1925, relating to "Sand Moulding Machines," is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above patent and ensuring its practical working in Great Britain.—All inquiries to be addressed to B. SINGER, Steger Building, Chicago, Illinois.

SALE BY PRIVATE TREATY.

TRAFFORD PARK, MANCHESTER.

For Sale by Private Treaty at a bargain price.

MODERN FOUNDRY—ERECTED 1921, with Railway Sidings into Works. Excellent Warehouse and Packing Room and fine Suite of Offices. Area of land 7,173 sq. yds., of which 2,850 are covered by a one-storey erection on same level. Easily adaptable for other trades.

To treat: F. S. AIREY, ENTWISTLE & COMPANY, 10, Norfolk Street, Manchester.

MACHINERY.

NEW Cylindrical Grinding Machine, grinding capacity 4 ft. 1 in. long x 11¾ in. dia.

TAFT-PIERCE Universal Cylindrical Grinding Machine, No. 2, 10 in. x 30 in.

Nearly New LANDIS Plain Cylindrical Grinder, 12 in. x 48 in.

BRYANT No. 6 Chucking Grinder, chuck range 12 in., maximum grinding length 9 in.

Two LANCASHIRE BOILERS, 30 ft. x 8 ft., reinsure 110 lbs. pressure.

SEVERAL HUNDREDS of TANKS, rectangular and circular, 10 gallons capacity upwards.

Eight 4-WHEEL 14-in. LOCOMOTIVES (Hawthorn Leslie), 1920 make, steel firebox and tubes, steam and hand brakes, 160 lbs. W.P.

Eight 4-WHEEL 12-in. LOCOMOTIVES (Avonside Engine Company), 1921 make, copper firebox, brass tubes, steam and hand brakes, 160 lbs. W.P.

CATALOGUE (10,000 Lots) ON APPLICATION.

THOS. W. WARD LTD.,
ALBION WORKS, SHEFFIELD.

MACHINERY.—*Continued.*

WANTED, Morgan Coke-fired Tilting Furnace for melting brass; also Moulding Machines.—Box 972, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

FOUNDRY CRANE LADLES.—One 6-ton capacity, with worm tilting gear. One 15-ton capacity, for bottom pouring.—For further particulars, etc., write Box 982, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

GRIMES JOLTERS FOR SALE, CHEAP.—Two Grimes 48 in. x 30 in. Turnover Jolters; three Grimes 36 in. x 24 in. Turnover Jolters These machines are practically new.—Box 974, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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MISCELLANEOUS.

CHARCOAL.—Powdered, granulated, lump, blacking; inquiries invited.—J. BUCHANAN & COMPANY, Ashfield Road, Altrincham, Cheshire.

PATTERNS OF ALL DESCRIPTIONS. LARGEST WORKS IN THE MIDLANDS. QUOTATIONS BY RETURN.
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